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OF THE SAILS

ALSO, WEIGHTS AND SIZES OF ROPES ; MASTING, RIGGING, AND
SAILS OF STEAM VESSELS, ETC.

ILLUSTRATED WITH NUMEROUS WOODCUTS

By ROBERT KIPPING, N.A.

SAILMAKER, QUAYSIDE, NEWCASTLE

AUTHOR OF "MASTING, MASTMAKING, AND RIGGING OF SHIPS"

Fourteenth Edition



LONDON

CROSBY LOCKWOOD AND SON

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1898

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PREFACE.

THE Author is much gratified by the favourable reception which has been accorded to previous editions of his work, and by the sale of the last edition in so short a time. With an earnest desire to render each new edition more deserving of such public patronage, he has taken care to carefully revise the whole, making the corrections which he found to be necessary; and has, he hopes, improved the work by incorporating with it the most recent information afforded by modern practice and study. He has struck out some plans that have been totally abandoned, and has filled up the portions of vacant space, left by these omissions, with new matter, such as the recent Invention of Self-reefing and Furling Sails, by Colling and Pinkney; Rules for Measuring a Mizen or Spanker, with gaff fixed and boom unshipped; a Jib upon a new formation or construction of the canvass; a Table of Squares (which will be found very useful for determining the foot-gore of any fore and aft mainsail); and a Cutting-Board, or Table, by Charles Pittard, by the use of which the foreman or master sailmaker, who may avail himself of it, will be enabled, *easily*, to keep

twenty or thirty men employed without the assistance of a boy to hold up, or of going down upon his knees to mark his gores on the floor. The cost, complete, of one of these tables, made in London, is £5. The utility of such an invention is well worthy the attention of practical men.

The arrangement of the present work, as in previous editions, is such that everything is treated in a consecutive manner, with distinctive heads under each chapter. The Author would refer, in illustration, to his Table of Cloths, which has been found of great service to the working sailmaker, and which dispenses with calculation as to the number of inches the seams and tablings eat-in; also, to the Table of the Givings of Gores, as being the groundwork of the whole practice of cutting out sails; and, also, to numerous other tables, calculations, and examples, which are given copiously throughout the work. Also, additional illustrations in carefully-executed engravings.

The Appendix contains new and important matter; and, as the whole work is applicable to all descriptions of vessels, whether sailing or steam—including gunboats and screw-colliers, &c.—the Author believes that his work will be of service to a numerous class, and at a price within the reach of all.

R. K.

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Rudimentary Treatise ON SAILS AND SAILMAKING.

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SECTION FIRST.

CHAPTER I.

ON DESCRIPTION AND USE OF SAILS.

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SAILS are an assemblage of several breadths of canvass, or other texture, sewed together, and extended on or between the masts, to receive the wind and impel the vessel through the water. The edges of the cloths, or pieces, of which a sail is composed are generally sewed together with a double seam, and the whole is skirted round at the edges with a cord called the bolt-rope.

It would appear from writers on the ancient navies that the earliest known sails for propelling vessels were made square, and could be shifted so as to receive the wind in whatever its direction might be. They were attached to a yard, and transversely erected on a single mast, which was fixed in the middle of the ship, the hole in which it was inserted being called by the Greeks *μεσότης*, which in English means the step. To the advantage gained by the quadrangular sails we find added, at a very early period, the triangular sails. These seem to be the prevailing forms of all sails up to the present time; and these two forms of sails

were used at very early periods, by the Carthaginians, Egyptians, Greeks, and Phœnicians, who were, without doubt, the earliest navigators that passed the Pillars of Hercules.

The Ancients, as they increased the size of their vessels, found it necessary to give them more than one mast and a sail. This we find was the case in the vessels of great magnitude built by Ammon, 1030 years B.C., for we are informed that he built long and high ships impelled by sails, on the Mediterranean. The fleets which were sent against Syracuse, about 208 years B.C., had three, and even four masts. With regard to the Moderns, all ships, properly so called, are, as already observed, furnished with three masts. Those which have only one mast, or two, are not called ships by seamen, but vary their names according to the method of rigging.

In every system, whatever may be the number or shape of the sails, they all contain either three or four sides—that is, are either triangular or quadrilateral. The former of these, or three-sided, are sometimes spread by a yard, as lateen sails, or by a stay, as staysails, or by a mast, as shoulder-of-mutton sails; in all which cases the foremost leech or edge is attached to the yard, mast, or stay, throughout its whole length.

The latter, or those which are four-sided, are either extended by yards, as the principal sails of a ship, or by yards and booms, as the studding sails, drivers, ringtails, and all those sails which are set occasionally; or by gaffs and booms, as the mainsails of sloops and brigantines.

The principal sails of a ship are:—The courses, or lower sails; the topsails, which are next in order above the courses; and the top-gallant-sails, which are extended above the topsails.

The courses are:—The mainsail and foresail, main-staysail, fore-staysail, and mizen-staysail. The main-staysail is rarely used, except in small vessels.

In all quadrilateral sails, the upper edge is called the head; the sides, or skirts, are called the leeches; and the bottom, or lower edge, is termed the foot. If the head is parallel to the foot, the lower corners are denominated clues, and the upper corners earings.

In all triangular sails, and in those four-sided sails in which the head is not parallel to the foot, the foremost corner at the foot is called the tack, and the after-lower corner the clue. The foremost head is called the fore-leech, or luff, and the hindmost the after-leech.

The heads of most four-sided sails, and fore-leeches of lateen

sails, are attached to their respective yards, or gaffs, by rope-yarns, called stoppers, or by a lacing; and the upper extremities are made fast by earings.

The staysails are extended upon stays between the masts, whereon they are drawn up or down; and their lower parts are stretched out by a tack and sheet.

The mainsail and foresail have a rope, and a large single block, or chain, made fast to each clue. The ropes or chains, called tacks, lead forward to the chess-trees and bumkins; and the block receives a thick rope from aft, which is termed the sheet.

The clues of the topsails are drawn out to the extremities of the sheave-holes, on the lower yards, by two chains called topsail-sheets; and the clues of the topgallant sails are in like manner extended upon the topsail-yards, close home to the sheave-holes, by chains called topgallant sheets. The royals are set above the topgallant-sails, and skysails above the royals; and above them are sometimes sails called moonsails, and star-gazers; and the clues of the royalsails have sheets leading through sheaves, or holes, of the top-gallant yard-arms.

Studding-sails are set beyond the leeches, or skirts, of the foresail, topsail, topgallant-sail, and royal, their upper and lower edges being extended by yards, and booms run out beyond the extremities of the yards for this purpose. These sails are, however, only used in favourable winds and moderate weather.

All sails derive their names from the mast, yard, or stay upon which they are extended, or to which they are attached. Thus, the principal sail extended upon the mainmast is called the mainsail, or maincourse; the next above, which stands upon the main-topmast, is termed the main-topsail; that which spreads upon the main-topgallant-mast, is named the main-topgallant-sail; and the sails above it are called the main-royal and main-skysail.

In the same manner there are the foresail, or fore-course, fore-topsail, fore-topgallant-sail, and fore-royal; the mizen, or driver, mizen-topsail, mizen-topgallant-sail, and mizen-royal. Thus, also, there are the fore-trysail, main-trysail, and mizen-trysail; or, as they are sometimes called, the fore-spencer, Duke of York, or main-spencer, and storm-mizen, or storm-driver, or spanker; the main-staysail, main-topmast-staysail, main-topgallant-staysail, and a middle-staysail, which stands between the two last. All these staysails are between the main and fore-masts.

The staysails are denominated from the stays ; and there are the mizen-staysail, the mizen-topmast-staysail, the mizen-topgallant-staysail, and sometimes a mizen-royal-staysail and main-spilling-staysail.

The sails between the foremast and the bowsprit are the fore-staysail, the fore-topmast-staysail, the jib, and the flying-jib, and even a middle-jib.

The studding-sails being extended upon the different yards of the mainmast and foremast, are also named according to their stations, as the lower-studdingsail, topmast-studdingsail, topgallant-studdingsail, and royal studdingsail.

The ropes by which the lower yards of a ship are hoisted to their proper height on the masts, are called purchases. The sails are expanded by halliards, tacks, sheets, and bowlines, and are drawn up together, or trussed up, by buntlines, clue-garnets, leech-lines, reef-tackles, slab-lines, and spilling-lines. The studding-sails, and the jibs and staysails, are drawn down, so as to be taken in or reefed, by down-hauls ; and the courses, topsails, and topgallant-sails hauled about the mast or the yards, so as to suit the various directions of the wind, by braces or the yards.

The *jib* is a sail of great command with any side wind, but especially when the ship is close-hauled, or has the wind upon her beam ; and its effect in casting the ship, or turning her head to leeward, is very powerful, and of great utility, particularly when the ship is working through a narrow channel.

The *flying-jib* is a sail much used in fine light winds, set upon a boom, and rigged out beyond the jib-boom ; and several ships have got an *inner-jib*, a similar sail, set between the fore-topmast-staysail and standing-jib, the tack of which is made fast near half-way down on the jib-boom.

The *after-sails*, which are those that belong to the mainmast and mizenmast, keep the ship to windward ; on which account, ships sailing on a quarterly wind require a head-sail and an after-sail—one to counteract the other.

When a ship sails with a side wind, the clues of the fore and main courses are fastened by a tack and sheet, the tack being to windward and the sheet to leeward. The tack is, however, only disused with a stern wind, whereas the sail is never spread without the assistance of one or both of the sheets.

It is under the topsails that many important evolutions are made, especially in time of emergency ; and they are justly accounted the principal sails in a ship.

CHAPTER II

ON MEASURING.

On measuring masts, yards, booms, &c., on board.—The full extent is measured.—Measuring for topsails, topgallant-sails, and royals, with remarks thereon.—Measuring courses:—Fore-course, boom-foresail, main-course, staysails.—Fore and aft mainsails, try-sails, gaff-top-sails, studding-sails.—Awnings:—Forecastle awning, maindeck awning, quarter-deck awning, poop or after-awning, and curtains to awnings.

The width of all sails is governed by the length of the yard, gaff, boom, and stay: the depth by the height of the mast. The total extent of either is always taken, and the allowances for the sails stretching are left to the judgment of the sail-maker.

TOPSAILS.

Heads.—The top-sail-yards are measured from cleat to cleat on the yard-arms, as O to O.

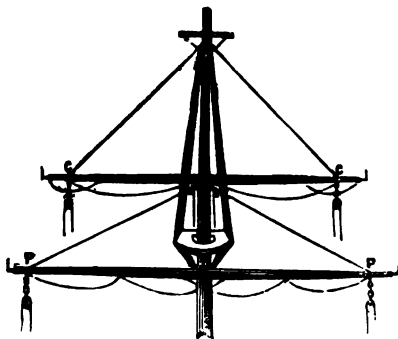
This measurement is essential for determining the length of the close-reef, when it is to be within the lifts.

Fcet.—The fore, main, and cross-jack yards are measured from pin to pin of the sheave-holes for the sheets, as P to P.

Hoists.—The topmasts are measured from the hounds down to the heel, and small vessels, from 250 to 300 tons, from the pinholes down to the heel of the topmast.

The greatest care is necessary in measuring the hoist of top-sails for some vessels, and especially foreigners, as their lower yards hang much below the ordinary distance from the heel of the topmast.

It is to be observed, however, that the measure from the *iron spider hoop* H (round the hounds of the topmast, with eyes for



the topgallant rigging to set up), down to the centre of the lower yard, equals the full drop of the topsails to the lower yards, when their own yards are hoisted as far as the spider hoop, where they cannot go higher up; and allowance must be made for stretching, for the sail to set taut up:—Suppose the measure of a topmast, from the heel to the pinhole, 25 feet 6 inches, and the band for the truss of lower yard 3 feet 4 inches below the hounds of lower mast; the distance from the spider hoop down to the centre of main yard, 27 feet; then the allowance for the sail stretching would be 1 foot 6 inches—that is, 2 inches to the yard in hoist.

The gore in the foot should be deducted from this hoist, for the depth of the middle of the sail.

Some sailmakers cut the *hoist* of their topsails different from what is directed here: they measure from the heel of the topmast to the lower part of the sheave-hole to cut the middle by, and put a *three-feet* gore in the foot, because they fancy it will not give hoist enough otherwise; afterwards, in roping the leeches, they take in most of the slack canvass to shorten the hoist, not considering that they are making the sail to *bag*, and by so doing lessening the effect of the sail; moreover, unless the slack in the leeches is stretched *flat* out, the sail will never stand against a wind.

TOPGALLANT SAILS.

Heads.—The topgallant-yards are measured from cleat to cleat on the yard-arms.

Feet.—The topsail-yards are measured from pin to pin of the sheaves.

Hoists.—The topgallant-masts are measured from the hounds down to the heel.

To this measurement one foot is added, on account of the topsail-yard not hoisting higher than the spider hoop, and in order to allow for the topsail stretching upwards.

ROYALS.

Heads.—The royal yards are measured from cleat to cleat on the yard-arms.

Feet.—The topgallant-yards are measured from pin to pin of the sheaves.

Hoists.—The royal masts are measured from the hounds down to the houn is of the topgallant-mast.

COURSES.—FORE-COURSE.

Head.—The fore-yard is measured from cleat to cleat on the yard-arms.

Depth.—The height of the centre of the yard from the deck, and of the cat-head above the deck; or, if the yard be sharply braced forward, measure the distance between the place of the earing and the bumkin end.

Should it happen that the yard is taken down, measure from the band or truss-hoop to the deck, and from the cat-head to the deck, for the length of the leeches.

Foot.—Measure from the cat-head, or bumkin* end, to two feet distance from the fore-part of the foremast, for half the spread of the foot: the allowance for the tack blocks and stretching of the foot must be taken off this measurement.

The *two feet* before the mast, here allowed, is on account of the yard projecting from the mast by the truss for bracing the yard.

When the half-spread of the foot is found to be less than the half-length of the yard, the foot requires to be narrowed. Thus, in some cases, one cloth on each side less than the cloths in the head is required to bring the tack to the cat-head; while in other ships, which have the foremast far forward, two goring cloths on each side are required; that is, there should be four cloths less in the foot than in the head. This difference in quantity, however, can be obviated by having bumkins fixed sufficiently forward to bring the tack properly down, because it will be better to lessen the narrowing of the foot (not only on account of gaining sail, and for appearance), but the sail will, in general, stand closer to the wind with parallel leeches.

BOOM-FORESAIL.

Head.—Measure the length of the fore-yard between cleat and cleat.

Foot.—Measure the length of the boom between the two holes. N.B. The foot is in general narrower than the head.

Depth.—The height of the centre of the yard from the mainstay; or, if the boom is hanging in its place, measure the distance between it and the centre of the yard.

* *Bumkin*, or *Boomkin*, is a short boom, or beam of timber, projecting from each side of the bow of a ship, to extend the clue or lower corner of the foresail to windward; for which purpose there is a large block fixed on its outer end, through which the tack is passed, which being drawn tight down, the tack is said to be aboard.

MAIN-COURSE.

Head.—The main-yard is measured from cleat to cleat on the yard-arms.

Depth.—The height of the centre of the yard from the deck; or, if the yard be sharply braced forward, the distance from the place of the earing to the chess-tree.

Foot.—From two feet distance from the main-mast, or as much as the centre of the yard stands from the mast, measure in a line to the *chess-tree** and parallel to the deck; deduct the allowance for the extension of the tack, which is from 3 to 6 feet, for half the spread of the foot.

There are seldom more than *two goring* cloths in the leeches of main-courses. By making the leeches to run nearly in a line with the leeches of the topsails, they have a better appearance than otherwise: this plan, however, cannot always be accomplished, on account of the limits prescribed for the spread between the tack and sheet blocks, and for the sail to stand well. That the sail may stand well, there must be an equal pull on both the foot and leech-ropes; for, if the sail is acted on too much on the leech, the foot will become slack, or, if too much on the foot, the leech will become slack; consequently, too much care cannot be taken in measuring and cutting the sail to fit, since the action of the sail as well as the working of the ship depend on these points.

STAYSAILS.

MAIN-STAYSAIL.

Stay.—The length of the main-stay between the mouse and the foremast.

Depth.—Measure from the place of the peek plumb down, so that the foot will clear the boat, &c.

FORE-TOPMAST STAYSAIL.

RULE.—The *length of the leech* = the hounded length of the fore-topmast. The *foot* contains as many cloths as there are yards in the leech. Thus—a fore-topmast, hounded, = 27 ft. 3 in.; or if the leech be 9 yards, the foot will require 9 cloths.

* *Chess-tree*, is a piece of timber with a sheave in it, secured to the sides of a ship, for extending the tack of the main-course to windward:—the sheet is then hauled aft to leeward. Small vessels have the tacks of their main-courses extended to a kind of stout thimble fitted in the top part of the rail, or through an eye-bolt, about a foot below the rail, into a stanchion; or sometimes, through an eye-bolt into the water-ways and beam

FORE-STAYSAIL.

RULE.—The *foot* of this sail should have two cloths more than half the number of cloths in the head of the fore-course, cut straight. The *depth of the leech* is the same as that of the fore-course.

MIZEN-STAYSAIL.

RULE.—The *foot* should be equal to one-half the number of cloths in the head of the main-course. The *depth of the leech* should be seven-eighths of the depth of the main-course. When cut with a knock, the *mast* should be two-thirds the depth of the leech, having two mast-gores.

MAIN-TOPMAST STAYSAIL.

Stay.—The length of the main-topmast stay between the collar and the fore-mast; the luff or stay is made 6 to 8 feet short of this measure.

Foot.—Measure from the place of the tack to where the sheet is required to be aft.

N.B.—When this sail is not cut of a triangular form, one to two cloths are generally gored on the bunt, so as to make the cloths in the stay more than are in the foot, thus:—if there be 13 cloths in the foot, by putting two goring cloths on the bunt, there will be 15 cloths in the stay.

Leech.—The length of the leech is governed by the angle of the stay,* the gore on the foot, and the length of the fore-leech or knock. (See sketches in another part of the work).

The shape and size of staysails, it may be observed, is often left to the person who has command of the vessel, and we find great difference of opinions about those kinds of sails; some like them with a jib-tack, and others with a long weather-leech, and the sheet cut down to the stay underneath. In the Royal Navy, staysails are all now made triangular, except the main-topmast staysail, which has a mast or knock.

The most correct method for obtaining the proper shape and size of staysails, is to find the angles of the several stays, the distances between the masts, and how far the stays are apart; afterwards make a draft of the sails. Staysails are coming into

* In setting up the main-topmast stay, no general method seems to be observed, for we find numerous ships with this stay set up to various places, such as the foremast-cap, foremast-head, and, in long ships, to the deck, alongside of the main-stay. In the Royal Navy, there are two main-topmast stays—one sets up at the fore-mast-head to a collar, which is put on under the third pair of shrouds; the other stay passes through a block or over a roller at the foremast-head, *either under or over the top*, and coming down close abaft the mast, sets up to an iron-bound heart on deck.

so much use now, both in large ships and smaller ones, that several captains are doing away with fore and main spencers, and supplying instead main-topmast, top-gallant, and royal staysails; mizen, mizen-topmast, and top-gallant staysails, and also a fore-staysail, which are all hoisted on *wire* stays in several ships. One thing is to be observed, a ship will keep much better to windward with trysails and a fore-staysail, than under the staysails alone.

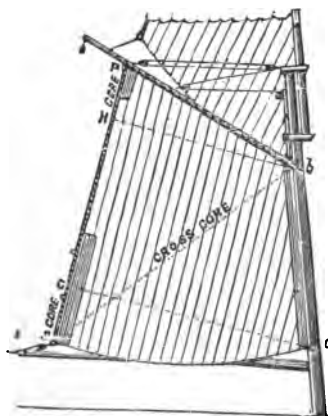
FORE-AND-AFT MAINSAILS, MIZENS, ETC.

Head.—Measure from the inside of the jaws of the gaffs to the hounds.

Foot.—Measure the length of the boom from the after-side of the mast, or from the jaws to the sheave-hole at the end.

Fore-leech.—Measure from the under part of the hounds to the boom, or from the under part of the gaff, hoisted to its proper height, to the boom.

Diagonal or Cross-gore.—The diagonal length is taken from the throat or height of gaff



on the mast, to the place of sheet cringle. This is done to get the foot-gore, from the draft made of the sail, thus:—

Make ab equal the length of the fore-leech. On ab , with the length of as and bs , construct the triangle abs .* In a similar way construct the triangle Pbs , with the lengths of the head bP and leech sP . From a and b draw aG and bH square to Ps ; Gs will be the *foot-gore*, and PH the *head-gore* required.

After-leech.—When with standing tyes to gaffs, have the boom topped up to its sailing position, or place where they carry it at sea; then, for the length of the after-leech, measure

* It is clear that the four sides will not be sufficient for drawing the figure of this sail, as the figure may be moved out of its position; we must, therefore, take the diagonal length, to keep the four sides of the figure in proper shape. Many blunders are committed by persons who never take more than the three or four sides of the sail, when it is evident that it may be put out of shape by increasing or decreasing the quantity of gore in the head or foot.

from the inner part of sheave-hole in the gaff, down to the inner part of sheave-hole in the boom, and make the allowance after, which is generally two or three feet—the weight of the boom and the stretching of the sail, brings the leech to its proper length, by the time the ship has made one voyage.

FORE-TRYSAIL.

Head.—Measure the length of the gaff.

Foot.—Measure from the main-stay, where it crosses the foremast, to the fore part of the gangway.

Fore-leech.—The height of the gaff standing above the main-stay or place of tack.

Diagonal.—Measured in the same way as the preceding.

GAFF-TOPSAIL.

Mast.—Measure from the sheave-hole of the topmast, or the place the throat reaches (when there is a short gaff), down to the gaff hoisted to its proper place.

Foot.—Measure the length of the gaff to the hounds.

Diagonal.—Let the gaff be properly peeked, and measure the distance between the places of the head or throat and clue.

Leech.—The *diagonal* length between the topgallantmast-head and the hounds of the gaff, peeked as above, for a jib-headed gaff-topsail. (See adjoining sketch.)



STUDDINGSAILS.

LOWER-STUDDINGSAIL.

RULE.—The *number of cloths* should be two-thirds of the quantity of cloths in the head of the foresail, with two cloths more in large ships. The *depth of the leech*, the same as the fore-course.

MAIN-TOPMAST AND TOPGALLANT STUDDINGSAILS.

RULE.—The *main-top and topgallant studdingsails* are one-half the respective cloths in the head of fore-topsail and top-

gallant-sails. Four cloths are gored on the outer-leech of the topmast-studdingsails, and three cloths of the topgallant-studdingsails.

FORE-TOPMAST AND TOPGALLANT STUDDINGSAILS.

RULE.—One *cloth* less than the maintop and topgallant studdingsails. The *depth of the inner leeches* is 9 inches shorter than that of the leeches of the respective topsails and topgallantsails.

AWNINGS.

FORECASTLE AWNING.

Measure the *length* from the fore-end, or forestay, to the afterside of the foremast.

Breadths.—Measure the distances between the two cat-heads, middle-way, and fore-part of fore-rigging. The breadth of fore-end is generally 3 feet.

MAIN-DECK AWNING.

The *length* is taken from the afterside of foremast to afterside of mainmast.

The *breadths* are taken at the forepart of fore-rigging and main-rigging.

QUARTER-DECK AWNING.

The *length* is taken from the afterside of the mainmast to the foreside of the mizen-mast.

The *breadths* are at the fore-part of main-rigging and mizen-rigging.

POOP, OR AFTER-AWNING.

The *length* is from the foreside of the mizenmast to the rake of the stern over the taffrail.

The *breadths* are at the fore-part of mizen-rigging and at the taff-rail.

CURTAINS TO AWNINGS.

Their depth is taken from the sides of the awning to the gunwale, supposing the awning to be in its place.

CHAPTER III.

RULES FOR FINDING THE NUMBER OF CLOTHS.

The seams and tablings vary in the breadth, according to the size of the sail.—Heads of topsails and courses: what gives the number of cloths.—Heads of topgallant sails: what gives the number of cloths.—Table showing the number of cloths.—The foot of trysails and mizens: what gives the number of cloths.—For the heads of mizens.—For the foot of a jib.—Given the number of cloths in the head and foot, and the length of the reef, to find the hollow in the two leeches.

The usual width of British canvass for the making of sails is twenty-four inches; and, when calculating the number of cloths required for a limited width, it must be observed that the breadth of the seam is to be taken off every cloth, except one, as the number of seams is always less than the number of cloths by one, thus:—if there be 20 cloths in a sail, there will be 19 seams in it. The breadths of seams vary according to the size of the sail, such as the breadth of the seams of courses, topsails, and other transverse sails. The breadths vary as follows, viz, courses and topsails for 500-ton ships and upwards, one inch and three-eighths to one inch and a half; and for 400 ton-ships and under, one inch and a quarter at head and foot; all other transverse sails one inch and one-eighth to one inch. The tablings, too, vary proportionably to the size of the sail, viz, courses from 4 to 6 inches, topsails 3 to 5 inches, and topgallant-sails 3 inches, on the leeches. Whence, if the width of any sail is in feet, or feet and inches, instead of reckoning up the number of inches the seams and tablings eat in, it may be multiplied by a fraction, such as $\frac{6}{11}$ for the finding of the number of cloths in the heads for courses and topsails, and $\frac{6}{13}$ for topgallant-sails and royals.

An easy method for finding the number of Cloths.—Take hold of your measuring line at the definite width, and apply it at 22 inches on a scale or a carpenter's rule; the number of 22 inches contained in the width, will be the number of cloths required for the heads of courses and topsails. In a similar way, from $22\frac{1}{2}$ inches on the rule, and at the width on the line proceed to the number of times $22\frac{1}{2}$ inches are contained in the width, gives the cloths in the heads for topgallant-sails and royals.

RULES.

I. For the foot of topsails and topgallant sails : $\frac{1}{13}$ of the length of the foot on a square gives the number of cloths.

EXAMPLES.

1. Given the length of the foot of a topsail, 39 feet, to find the spread of cloths ?

	FT.
Here - - - - -	39
Multiply by - - -	7
	<hr/>
Divide by - - - 13)	273(21 cloths
	26
	<hr/>
	13
	13
	<hr/>

2. Given the foot on a square of a topgallant-sail, 26 feet, to find the number of cloths the foot spreads ?

	FT.
Here - - - - -	26
Multiply by - - -	7
	<hr/>
Divide by - - - 13)	182(14 cloths
	13
	<hr/>
	52
	52
	<hr/>

II. For the foot of topsails and topgallant-sails having cringles in lieu of turned clues, $\frac{1}{4}$ of the length of the foot gives the requisite number of cloths.

EXAMPLE.

Given the length of the foot of a topsail, 36 feet : to find how many cloths are required ?

	FT.
Here - - - - -	36
Multiply by - - -	4
	<hr/>
Divide by - - - 7)	144
	<hr/>

20 cloths

THE RULES FOR FINDING THE CLOTHS OF FORE AND AFT SAILS.

The breadths of the seams being made broader on the head and foot, or foot only, are to be as follows, viz., trysails, mizens, and drivers, two inches and a half at the head, and three inches on the foot, except where the gores are stronger towards the mast, and the seams are one quarter to one half-inch broader; the seams of *jibs* are three inches at the foot, increased towards the clue: but the seams ought to be creased, according to the roach with which the sail is cut, and thus eat up the irregular gores, and form a regular curve on the foot. The seams being made broader on the head and foot than the remaining part of the seam, forms what is called the belly part of the sail, restrained by the slack after-leech, which will be noticed afterwards.

I. For the foot of trysails and mizens, $\frac{24}{43}$ of the length of the foot gives the number of cloths.

EXAMPLES.

1. Given the length of the foot of a trysail, 29 feet: to find the number of cloths?

	FT.
Here - - - - -	29
Multiply by - - -	24
	<hr/>
	116
	58
	<hr/>
Divide by - - - 43	696 (16 cloths
	43
	<hr/>
	266
	258
	<hr/>
	3

2. Given the length of the foot of a mizen, 44 feet : to find the number of cloths ?

Here	- - - - -	FT.
Multiply by	- . .	24

176
88

Divide by	- - - 43	1056	(24½ cloths
		86	

196
172

24

II. For the heads of mizens, $\frac{5}{9}$ of the length of the head will give the number of cloths.

EXAMPLE.

1. Given the head of a mizen, 22 feet 6 inches : to find the number of cloths ?

Here	- - - - -	FT.	IN.
Multiply by	- - -	22	6
			5

Divide by	- - 9	112	6
-----------	-------	-----	---

12½ cloths.

III. For the foot of a jib, $\frac{12}{36}$ of the length of the foot, will give the number of cloths.

EXAMPLES.

1. Given the length of the foot of a jib 26 feet 6 inches, to find the number of cloths ?

Here	- - - - -	FT.	IN.
Multiply by	- - -	26	6
			19

243
26

Divide by	- - 36	503	(14 cloths.
		36	

143
144

2. Given the length of the foot of a jib, 32 feet : to find the number of cloths ?

	FT.
Here - - - -	32
Multiply by - - -	19

288
32

Divide by - - - 36) 608 (17 cloths nearly

36

248
252

ON FINDING THE NUMBER OF CLOTHS IN THE CLOSE REEF, AND THE QUANTITY OF HOLLOW IN THE TWO LEECHES OF A TOPSAIL.

Given the number of cloths in the head and foot and the length of the reef, to find the hollow in the two leeches.

EXAMPLE.

Given the head 15 cloths, foot 24 cloths, and the length of the low reef at 1 foot above half way of the leech, 32 feet ?

	FT.	Head 15 cloths.
Here - - Reef 32		Foot 24 ditto.
Multiply by 6		

11) 192

17½ cloths.

½) 39 sum.

19½ mean cloths.

17½

Diff. 2 cloths.

Hence, the hollow on each leech will be one cloth, or 2 feet.

. The method of fixing the length on the head of the topsail, or the distance of the head of the sail from the cleats on the topsail-yard, will cause the hollow given to the leeches of the topsails always to be more or less, according as the lengths of the lower yards exceed the lengths of the topsail-yards, which, in some cases, may give a very considerable hollow, as in the example shown above. But topsails stand *flatter* by having a little hollow in the leeches, because they have a tendency to stretch themselves into a straight edge, and draw out the belly of the sail, which straight leeches cannot do, though they look better.

☞ The number of cloths for courses, topsails, &c., can be expeditiously found by looking into the following tables, where the cloths are placed against the width.

TABLE OF CLOTHS.—Showing the number of cloths required for the width, from 7 cloths to 41½ cloths, advancing by ½ of a cloth; and breadths of seams

Breadths of Seams 1 inch. Tablings 2½ to 3½ inches.						Seams 1½ in. Tablings 4 inches.		Seams 1½ inches. Tablings 3 to 4½ inches.			
Width.	Eql.	Width.	Eql.	Width.	Eql.	Width.	Eql.	Width.	Eql.	Width.	Eql.
Ft. In.	Clo.	Ft. In.	Clo.	Ft. In.	Clo.	Ft. In.	Clo.	Ft. In.	Clo.	Ft. In.	Clo.
13 1	7	28 9	15½	44 7	23½	30 1	16	16 8	9	32 1	17½
13 7	7½	29 3	15½	45 1	23½	30 6	16½	17 0	9½	32 7	17½
14 0	7½	29 9	15½	45 7	24	31 0	16½	17 6	9½	33 1	17½
14 6	7½	30 3	16	46 0	24½	31 6	16½	18 0	9½	33 7	18
15 0	8	30 8	16½	46 6	24½	32 0	17	18 6	10	34 0	18½
15 4	8½	31 2	16½	47 0	24½	32 5	17½	18 11	10½	34 6	18½
15 10	8½	31 8	16½	47 6	25	32 11	17½	19 5	10½	35 0	18½
16 4	8½	32 2	17	47 11	25½	33 5	17½	19 11	10½	35 6	19
16 10	9	32 7	17½	48 5	25½	33 11	18	20 5	11	35 10	19½
17 3	9½	33 1	17½	48 11	25½	34 4	18½	20 10	11½	36 4	19½
17 9	9½	33 7	17½	49 5	26	34 10	18½	21 4	11½	36 10	19½
18 3	9½	34 1	18	49 10	26½	35 4	18½	21 10	11½	37 4	20
18 9	10	34 6	18½	50 4	26½	35 10	19	22 4	12	37 9	20½
19 2	10½	35 0	18½	50 10	26½	36 3	19½	22 9	12½	38 3	20½
19 8	10½	35 6	18½	51 4	27	36 9	19½	23 3	12½	38 9	20½
20 2	10½	36 0	19	51 9	27½	37 3	19½	23 9	12½	39 3	21
20 8	11	36 5	19½	52 3	27½	37 9	20	24 3	13	39 8	21½
21 1	11½	36 11	19½	52 9	27½	38 2	20½	24 8	13½	40 2	21½
21 7	11½	37 5	19½	53 3	28	38 8	20½	25 2	13½	40 8	21½
22 1	11½	37 11	20	53 8	28½	39 2	20½	25 8	13½	41 2	22
22 7	12	38 4	20½	54 2	28½	39 8	21	26 2	14	41 7	22½
23 0	12½	38 10	20½	54 8	28½	40 1	21½	26 7	14½	42 1	22½
23 6	12½	39 4	20½	55 2	29	40 7	21½	27 1	14½	42 7	22½
24 0	12½	39 10	21	55 7	29½	41 1	21½	27 7	14½	43 1	23
24 6	13	40 3	21½	56 1	29½	41 7	22	28 1	15	43 5	23½
24 11	13½	40 9	21½	56 7	29½	42 0	22½	28 6	15½	43 11	23½
25 5	13½	41 3	21½	57 1	30	42 6	22½	29 0	15½	44 5	23½
25 11	13½	41 9	22	57 6	30½	43 0	22½	29 6	15½	44 11	24
26 5	14	42 2	22½	58 0	30½	43 6	23	29 9	16	45 4	24½
26 10	14½	42 8	22½	58 6	30½	43 11	23½	30 2	16½	45 10	24½
27 4	14½	43 2	22½	59 0	31	44 5	23½	30 8	16½	46 4	24½
27 10	14½	43 8	23	59 5	31½	44 11	23½	31 2	16½	46 10	25
28 4	15	44 1	23½	59 11	31½	45 5	24	31 8	17	47 3	25½

from 1 inch to $1\frac{1}{2}$ inch, advancing by $\frac{1}{2}$ of an inch. The widths are arranged in the first column, and the number of cloths required will be found opposite.

Seams $1\frac{1}{2}$ in. Tablings 3 to 4 in.			Seams $1\frac{1}{2}$ inches. Tablings 4 to 5 inches.								Seams $1\frac{1}{2}$ inches. Tablings 5 to 6 inches.			
Width.	Eq.		Width.	Eq.		Width.	Eq.		Width.	Eq.		Width.	Eq.	
Ft. In.	Clo.		Ft. In.	Clo.		Ft. In.	Clo.		Ft. In.	Clo.		Ft. In.	Clo.	
47 9	25 $\frac{1}{2}$		31 6	17		46 10	25 $\frac{1}{2}$		62 5	33 $\frac{1}{2}$		40 6	22	
48 3	25 $\frac{1}{2}$		31 11	17 $\frac{1}{2}$		47 4	25 $\frac{1}{2}$		62 11	33 $\frac{1}{2}$		40 11	22 $\frac{1}{2}$	
48 9	26		32 5	17 $\frac{1}{2}$		47 10	25 $\frac{1}{2}$		63 5	34		41 5	22 $\frac{1}{2}$	
49 2	26 $\frac{1}{2}$		32 11	17 $\frac{1}{2}$		48 4	26		63 10	34 $\frac{1}{2}$		41 11	22 $\frac{1}{2}$	
49 8	26 $\frac{1}{2}$		33 5	18		49 8	26 $\frac{1}{2}$		64 4	34 $\frac{1}{2}$		42 5	23	
50 2	26 $\frac{1}{2}$		33 9	18 $\frac{1}{2}$		49 2	26 $\frac{1}{2}$		64 10	34 $\frac{1}{2}$		42 9	23 $\frac{1}{2}$	
50 8	27		34 3	18 $\frac{1}{2}$		49 8	26 $\frac{1}{2}$		65 4	35		43 3	23 $\frac{1}{2}$	
51 0	27 $\frac{1}{2}$		34 9	18 $\frac{1}{2}$		50 2	27		65 8	35 $\frac{1}{2}$		43 9	23 $\frac{1}{2}$	
51 6	27 $\frac{1}{2}$		35 3	19		50 7	27 $\frac{1}{2}$		66 2	35 $\frac{1}{2}$		44 3	24	
52 0	27 $\frac{1}{2}$		35 6	19 $\frac{1}{2}$		51 1	27 $\frac{1}{2}$		66 8	35 $\frac{1}{2}$		44 8	24 $\frac{1}{2}$	
52 6	28		36 0	19 $\frac{1}{2}$		51 7	27 $\frac{1}{2}$		67 2	36		45 0	24 $\frac{1}{2}$	
52 11	28 $\frac{1}{2}$		36 6	19 $\frac{1}{2}$		52 1	28		67 7	36 $\frac{1}{2}$		45 6	24 $\frac{1}{2}$	
53 5	28 $\frac{1}{2}$		37 0	20		52 6	28 $\frac{1}{2}$		68 1	36 $\frac{1}{2}$		46 0	25	
53 11	28 $\frac{1}{2}$		37 4	20 $\frac{1}{2}$		53 0	28 $\frac{1}{2}$		68 7	36 $\frac{1}{2}$		46 5	25 $\frac{1}{2}$	
54 5	29		37 10	20 $\frac{1}{2}$		53 6	28 $\frac{1}{2}$		69 1	37		46 11	25 $\frac{1}{2}$	
54 10	29 $\frac{1}{2}$		38 4	20 $\frac{1}{2}$		54 0	29		69 5	37 $\frac{1}{2}$		47 5	25 $\frac{1}{2}$	
55 4	29 $\frac{1}{2}$		38 10	21		54 4	29 $\frac{1}{2}$		69 11	37 $\frac{1}{2}$		47 11	26	
55 10	29 $\frac{1}{2}$		39 3	21 $\frac{1}{2}$		54 10	29 $\frac{1}{2}$		70 5	37 $\frac{1}{2}$		48 5	26 $\frac{1}{2}$	
56 4	30		39 9	21 $\frac{1}{2}$		55 4	29 $\frac{1}{2}$		70 11	38		48 9	26 $\frac{1}{2}$	
56 8	30 $\frac{1}{2}$		40 3	21 $\frac{1}{2}$		55 10	30		71 4	38 $\frac{1}{2}$		49 3	26 $\frac{1}{2}$	
57 2	30 $\frac{1}{2}$		40 9	22		56 3	30 $\frac{1}{2}$		71 10	38 $\frac{1}{2}$		49 9	27	
57 8	30 $\frac{1}{2}$		41 2	22 $\frac{1}{2}$		56 9	30 $\frac{1}{2}$		72 4	38 $\frac{1}{2}$		50 2	27 $\frac{1}{2}$	
58 2	31		41 8	22 $\frac{1}{2}$		57 3	30 $\frac{1}{2}$		72 10	39		50 8	27 $\frac{1}{2}$	
58 6	31 $\frac{1}{2}$		42 2	22 $\frac{1}{2}$		57 9	31		73 3	39 $\frac{1}{2}$		51 2	27 $\frac{1}{2}$	
59 0	31 $\frac{1}{2}$		42 8	23		58 2	31 $\frac{1}{2}$		73 9	39 $\frac{1}{2}$		51 8	28	
59 6	31 $\frac{1}{2}$		43 1	23 $\frac{1}{2}$		58 8	31 $\frac{1}{2}$		74 3	39 $\frac{1}{2}$		52 0	28 $\frac{1}{2}$	
60 0	32		43 7	23 $\frac{1}{2}$		59 2	31 $\frac{1}{2}$		74 9	40		52 6	28 $\frac{1}{2}$	
60 5	32 $\frac{1}{2}$		44 1	23 $\frac{1}{2}$		59 8	32		75 1	40 $\frac{1}{2}$		53 0	28 $\frac{1}{2}$	
60 11	32 $\frac{1}{2}$		44 7	24		60 0	32 $\frac{1}{2}$		75 7	4 $\frac{1}{2}$		53 6	29	
61 5	32 $\frac{1}{2}$		44 11	24 $\frac{1}{2}$		60 6	32 $\frac{1}{2}$		76 1	40 $\frac{1}{2}$		53 11	29 $\frac{1}{2}$	
61 11	33		45 5	24 $\frac{1}{2}$		61 0	32 $\frac{1}{2}$		76 7	41		54 5	29 $\frac{1}{2}$	
62 4	33 $\frac{1}{2}$		45 11	24 $\frac{1}{2}$		61 6	33		77 0	41 $\frac{1}{2}$		54 11	29 $\frac{1}{2}$	
62 10	33 $\frac{1}{2}$		46 5	25		61 11	33 $\frac{1}{2}$		77 6	41 $\frac{1}{2}$		55 5	30	

TABLE :

Showing the Number of Cloths required for a certain length on the foot of Courses, Topsails, &c.

ROYALS AND TOPGALLANT-SAILS.										COURSES AND TOPSAILS.									
Seams 1 inch. Tablings 3 to 4 inches.					Seams 1 in. to 1½ in. Tablings 3 to 4 inches.					Seams 1 in to 1½ in. Tablings 4 to 5 inches.					Seams 1½ in. to 1¾ in. Tablings 4 to 5 inches.				
No. of Cloths.	Length of the Foot.	No. of Cloths.	Length of the Foot.	FT. IN.	No. of Cloths.	Length of the Foot.	No. of Cloths.	Length of the Foot.	FT. IN.	No. of Cloths.	Length of the Foot.	No. of Cloths.	Length of the Foot.	FT. IN.	No. of Cloths.	Length of the Foot.	No. of Cloths.	Length of the Foot.	FT. IN.
8	14 6	16½	30 0	13	24 0	21½	39 6	16	29 0	24½	45 0	27½	49 0	35½	64 3	44	78 8		
8½	15 0	16½	30 6	13½	24 6	21½	40 0	16½	29 6	24½	45 8	27½	49 6	36	64 6	44½	79 0		
8½	15 5	16½	31 0	13½	25 0	21½	40 6	16½	30 0	24½	46 0	28	50 0	36½	64 9	44½	79 5		
8½	15 10	17	31 6	13½	25 5	22	41 0	16½	30 6	25	46 4	28½	50 6	36½	65 0	44½	80 0		
9	16 6	17½	32 0	14	25 10	22½	41 6	17	30 10	25½	46 8	28½	51 0	36½	65 4	45	80 5		
9½	17 0	17½	32 6	14½	26 3	22½	42 0	17½	31 0	25½	47 0	28½	51 6	37	65 8	45½	81 0		
9½	17 6	17½	33 0	14½	26 8	22½	42 6	17½	31 6	25½	47 4	29	52 0	37½	66 0	45½	81 5		
10	18 0	18½	33 6	14½	27 0	23	43 0	17½	32 0	26	47 8	29½	52 4	37½	66 4	45½	82 0		
10½	18 6	18½	34 0	15	27 6	23½	43 6	18	32 6	26½	48 0	29½	52 8	37½	66 8	46	82 6		
10½	19 0	18½	34 6	15½	28 0	23½	44 0	18½	33 0	26½	48 4	29½	53 0	38	67 0	46½	83 0		
10½	19 6	18½	35 0	15½	28 6	23½	44 6	18½	33 6	26½	48 8	30	53 4	38½	67 4	46½	83 6		
10½	20 0	19	35 6	16½	28 9	24	45 0	18½	34 0	27	49 0	30½	53 8	38½	68 0	46½	84 0		

11	20	0	19½	36	0	16	29	0	24½	45	6	19	34	6	27½	49	4	30½	54	0	38½	68	6	47	84	6
11½	20	6	19½	36	6	16½	29	6	24½	46	0	19½	35	6	27½	49	8	30½	54	6	39	69	0	47½	85	6
11½	21	0	19½	37	0	16½	30	0	24½	46	6	19½	35	0	27½	50	0	31	54	0	39½	69	6	47½	85	0
11½	21	6	20	37	6	16½	30	6	25	47	0	19½	36	0	28	50	6	31½	55	6	39½	70	0	48½	86	6
12	22	0	20½	38	0	17	31	0	25½	47	6	20	36	6	28½	50	6	31½	55	6	39½	70	6	48½	86	6
12½	22	6	20½	38	6	17½	31	6	25½	48	0	20½	37	0	28½	51	5	31½	56	0	40	71	0	48½	87	0
12½	23	0	20½	39	0	17½	32	0	26½	48	6	20½	37	6	28½	52	0	32	56	6	40½	71	6	48½	87	6
12½	23	6	21	39	6	17½	32	6	26½	49	0	20½	38	0	29	52	6	32½	57	2	40½	72	0	49½	88	0
13	24	0	21½	40	0	18	33	0	26½	49	6	21	38	6	29½	53	0	32½	57	9	41½	72	6	49½	88	6
13½	24	6	21½	40	6	18½	33	6	26½	50	0	21½	39	0	29½	53	6	32½	58	3	41½	73	0	49½	89	0
13½	25	0	21½	41	0	18½	34	0	26½	50	6	21½	39	6	29½	53	10	33	58	9	41½	73	6	49½	90	0
13½	25	6	22	41	6	18½	34	6	27	51	0	21½	40	0	30	54	3	33½	59	3	41½	74	0	50½	90	6
14	25	10	22½	42	0	19	35	0	27½	51	6	22	40	6	30½	54	8	33½	59	9	41½	74	6	50½	90	8
14½	26	3	22½	42	6	19½	35	6	27½	52	0	22½	41	0	30½	55	0	33½	60	3	42½	75	0	50½	91	0
14½	26	8	22½	43	0	19½	36	0	27½	52	6	22½	41	6	30½	55	6	34	60	9	42½	75	6	50½	91	6
14½	27	0	23	43	6	19½	36	6	28	53	0	22½	42	0	31	55	10	34½	61	3	42½	76	0	50½	91	8
15	27	6	23½	44	0	20	37	0	28½	53	6	23	42	6	31½	56	3	34½	61	9	42½	76	6	51½	92	0
15½	28	0	23½	44	6	20½	37	6	28½	54	0	23½	43	0	31½	56	8	34½	62	3	43½	77	0	51½	92	4
15½	28	6	23½	45	0	20½	38	0	28½	54	6	23½	43	6	31½	57	0	35	62	9	43½	77	6	51½	93	0
15½	29	0	24	45	6	20½	38	6	29	55	0	23½	44	0	32	57	6	35½	63	3	43½	77	10	51½	93	6
16	29	6	24½	46	0	21	39	0	29½	55	6	24	44	6	32½	58	0	35½	63	9	43½	78	3	52	93	4

NOTE.—In the above table an allowance is made for slack-canvass to be taken-in in sewing on the foot-rope, such as will stretch out to the dimensions, and leave a portion in; for, if ever the strain be on the canvass, the seams will open or burst the canvass. It is always the better plan, before roping the foot, to have the rope on a stretch, and run a piece of chalk along the rope, and set the slack off, which ensures the foot being the proper length, and less attention is required to be paid to the slack, when roping, besides the line is a guide in keeping the rope straight.

CHAPTER IV.

ON FINDING THE QUANTITY OF YARDS IN SAILS.

The general practice amongst sailmakers. — Rules useful in making out estimates. — Rules for finding the quantity of yards in main and fore courses, topsails, &c.

The general practice is, amongst sailmakers, first to take an account of the canvass intended for the sail; and the canvass left over the sail which is cut, measured and deducted from the whole, leaves the quantity of yards in the sail.

It is desirable, however, to know, in making out estimates, the number of yards contained in sails for new ships, having their dimensions to go by, for which the following rules will be particularly useful.

RULES.

I. To find the quantity of yards in main and fore courses, main, fore, and mizen topsails, topgallantsails, royals, skysails, lower-studdingsails, topmast-studdingsails, topgallant-studdingsails, awnings, &c.

Add the number of cloths in the head and foot, and half the sum for the mean width; then multiply by the depth of the middle-cloth, and add the quantity contained in the foot-gores for the yards in the sail; to this sum add the respective linings, which gives the total quantity of yards.

To find the quantity of yards in the foot-gores.—Multiply the whole gore of the foot, by the number of cloths gored on one side of the sail, and bring it into yards.

EXAMPLES :—MAIN-TOPSAIL.

24	cloths in the head.
36	cloths in the foot.
—	
2)60	sum.
—	
30	half the sum.
13 $\frac{1}{2}$	yards deep.
—	
90	
30	
10	
—	
400	the product.

To find the quantity of yards in main-topsail (continued)
To find the quantity in the foot-gores ?

12 gores on each side.

2 feet gore.

3) 24 feet.

8 yards in the foot-gores.

400 the product of half sum and depth.

408 yards in the body of the sail.

29 " two leech-linings.

34½ " four double-reef banda.

10 " middle-band.

7 " reef-tackle pieces.

8 " foot-band.

6½ " two buntline-pieces.

58 " top-lining.

Total, 561 yards.

MAIN-COURSE.

34 cloths in the head.

38 cloths in the foot.

4) 72 sum.

36 half the sum.

12½ yards deep.

432

24

56 the product.

7½ yards in the foot-gores - 7½ yards.

463½ yards in the body of the sail.

28 " two leech-linings.

24 " four buntline-cloths.

7 " reef-band—one-third of a cloth.

11 " middle-band.

12 " foot-band.

Total, 545½ yards for a ship of 1,000 tons

To find the quantity in
the foot gores ?

7½ cloths gored on each side

3 feet gore.

3) 21½

MIZEN-TOPGALLANTSAIL.

13½ cloths in the head.

19 cloths in the foot.

½)32½ sum.

16½ square cloths.

5½ yards deep.

80½

1½

82½ the product.

18 yards in the foot-gores - 18 yards.

100½ yards in the body of the sail.

7½ " two leech-linings.

4 " foot-band.

11 " top-lining

Total, 122½ yards.To find the quantity in the
foot gores.

6 feet the foot-gores.

9 cloths gored on one side.

3)54

TOPMAST-STUDDINGSAIL.

To find the quantity in the gores :

Foot-gore, 5 inches.

11 cloths in the head.

Head-gore, 4 inches.

15 cloths in the foot.

Diff. - 1

½)26 sum.

Foot - - 15 cloths.

13 square cloths.

14½ yards deep.

15 inches.7½ half the cloths
[in the foot.

52

13

2

105

7½

36)112½ the product.

184 the product.

3 yards in the gores - - - 3 yards.

187 yards in the body of the sail.

FORECASTLE AWNING.

	FT.	IN.	Cathead - 20 feet.
Breadth at foremast -	27	6	End - - 3
	25	6	
Cathead to cathead -	20	0	2)23
	8)73	0	11½ feet.
		9 cloths.	12 cloths
	24	4 = 8½ yards.	
			3)138
		73 yards.	
		46 yards - - - -	46
		119 yards.	

WINDSAIL.

4	number of cloths.
8	yards in length.
32	
Sub.	1½ the opening.
30½	yards the tube.
3	" two wings.
¾	" top.
1¾	" bands.
Total,	36 yards.

II. To find the quantity of yards contained in jibs, fore-top-maststaysails, jib-gaff-topsails, and all triangular sails with curved edges.

Set down the depths of the stay and foot gores ; find the lengths of the cloths by adding the stay-gores. Take the sum of the first stay-gore at the tack, and the length of the leech, with the amount of foot-gore added ; then the sum of the second, fourth, sixth, or even lengths of the cloths, and multiply it by four ; and then take the sum of the remaining odd lengths, as third, fifth, &c., and multiply it by two. To the sum of these two products, add the sum of the extreme lengths. Subtract the quantity in the foot-gores, found in a similar way, and the remainder gives the number of yards.

EXAMPLE :—STANDING-JIB.

Add the depths of the stay and foot gores of the jib (see page 37), thus :—1st gore, 11 feet 6 inches; 1st and 2d, 11 feet 6 inches + 5 feet 6 inches = 17 feet; 17 added to 3d, or 17 feet + 4 feet 7 inches = 21 feet 7 inches, &c., and set them down as given below, viz. :—

	The Stay Gores added.		Even Lengths of the Cloths.		Odd Lengths.		The Foot Gores added.		Even	Odd
	FT.	IN.	FT.	IN.	FT.	IN.	IN.	IN.	Lengths.	Lengths.
1st	11	6	-	-	-	-	4	-	-	-
2d	17	0	-	17	0	-	9	-	9	-
3d	21	7	-	-	-	21	7	-	15	-
4th	25	10	-	25	10	-	22	-	22	-
5th	29	10	-	-	-	29	10	-	30	-
6th	33	8	-	33	8	-	39	-	39	-
7th	37	4	-	-	-	37	4	-	49	-
8th	40	10	-	40	10	-	60	-	60	-
9th	44	3	-	-	-	44	3	-	72	-
10th	47	7	-	47	7	-	85	-	85	-
11th	50	11	-	-	-	50	11	-	100	-
12th	54	2	-	54	2	-	117	-	117	-
13th	57	5	-	-	-	57	5	-	136	-
<hr/>										
14th	60	8	-	60	8	-	241	4	157	157
15th	63	11	-	-	-	-	2	181	-	402
										2
										<hr/>
										279 9
										<hr/>
										4
										<hr/>
										482 8
										<hr/>
										1119 0
										<hr/>
										482 8
										<hr/>
										11 6 1st.
										<hr/>
										63 11 15th.
										<hr/>
										9)1677 1
										<hr/>
										186 yards.
										<hr/>
										Subtract 27 - - - - -
										<hr/>
										Total, 159 yards in the body.

. This is a very correct method of finding the quantity of yards in any jib cut with a round stay and foot.

The most simple way of finding the quantity of canvass in a jib, or any sail of a triangular form, is to multiply the length of the after-leech (in yards), by half the number of cloths in the foot, thus :— 16 yards (depth of leech) \times $7\frac{1}{2}$ half the number of cloths, is equal to 120 yards : this supposes the foot and stay to be straight. The difference between the former calculation and this quantity is 39 yards, or $32\frac{1}{2}$ per cent., which amounts to the increased quantity of canvass in the roundness of the stay.

III. To find the quantity of canvass contained in the main and fore staysails.

Multiply half the number of cloths by the depth of the leech, and add the quantity in the pieces.

EXAMPLE :—MAIN-STAYSAIL.

10	half the number of cloths.
11	yards, depth of the leech.
<hr/>	
110	yards in the body of the sail.
4	“ “ pieces
<hr/>	

Total, 114 yards.

IV. To find the quantity of canvass contained in drivers, mizens, main-trysails, fore-trysails, brigs' mainsails, schooners' mainsails, sloops' mainsails, &c.

Add the number of cloths in the head and foot, and half the sum to make it square. Add together the depth of the mast-gores ; then multiply the number of square cloths by the depth of the mast. To this product add the quantity contained in the head and foot gores, and the slack cloth held in the sail for the yards in the sail. The quantity of yards contained in the foot, head, and slack cloth, is found thus :—Add the gores in the foot, from the tack to the square cloth near the clue, and multiply half the sum by the number of cloths in the foot ; then add together the gores from the clue to the square, and multiply half the sum by the number of cloths gored up the clue, which, subtracted from the product of the gores to the tack, gives the quantity in the *foot-gores*. In a similar way, find the quantity in the *head-gores*. Add together the inches of slack cloth there are in the seams, and multiply by half the number of cloths : the whole of these added will give the answer.

EXAMPLE :—BARQUE'S MIZEN.

	IN.		
	$\frac{1}{2}$) 102	gores to the tack.	
	51		$12\frac{1}{2}$ cloths in the head.
	17 cloths in the foot.		17 cloths in the foot.
IN.			
$\frac{1}{2}$) 6	gores to the clua.		$\frac{1}{2}$) $29\frac{1}{2}$
3	357		
3 cloths gored.	51		$14\frac{3}{4}$ square cloths.
	867		$8\frac{3}{4}$ yards the mast.
9 inches	Sub. 9		118
			$10\frac{1}{2}$
	36) 858	inches	
			$128\frac{1}{2}$ yards.
	$23\frac{3}{4}$ yards	- - -	$23\frac{3}{4}$ " foot-gores
IN.			
$\frac{1}{2}$) 33	slack in the seams.		
16 $\frac{1}{2}$			
6	cloths which have slack.		
36) 99	inches.		
	$2\frac{3}{4}$ yards	- - - - -	$2\frac{3}{4}$ " of slack.
IN.			
$\frac{1}{2}$) 45	gores to the peak.		
22 $\frac{1}{2}$			
$12\frac{1}{2}$	cloths in the head.		
270			
11			
36) 281	inches.		
	$7\frac{3}{4}$ yards	- - - - -	$7\frac{3}{4}$ " head-gores.
			[of the sail]
			Total, $162\frac{3}{4}$ yards in the body

V. To find the quantity of canvass contained in mizen and main-topmast staysails.

Add the number of cloths in the stay and foot together, and half the sum to make them square; add the depth of the bunt or fore-leech to the depth of the after-leech, and half them for a medium depth; then multiply the number of square cloths by the mean depth, and add the quantity in the linings and pieces.

EXAMPLE :—MIZEN-STAYSAIL.

Cloths in the stay	16	
Cloths in the foot	18	8 yards, depth of the leech.
—	—	2 $\frac{3}{4}$ “ “ bunt.
$\frac{1}{2}$)34	—	—
—	—	$\frac{1}{2}$)10 $\frac{3}{4}$
17 square cloths.	—	—
5 $\frac{1}{4}$ - - - -	5 $\frac{1}{4}$ mean depth.	—
—	—	—
85		
4 $\frac{1}{2}$		
—		
89 $\frac{1}{4}$ yards in the body of the sail.		
5 “	lining and pieces.	
—		

Total, 94 $\frac{1}{4}$ yards.

V. To find the quantity of canvass in boats' lugsails.

Add together the number of cloths in the head and foot, and half the sum to make it square; add the depth of the two leechees, and half the sum for a medium depth; then multiply the number of square cloths by the medium depth. To this product add the quantity in the foot-gore and pieces.

EXAMPLE.

FT. IN.

	Fore-leech	-	9	6
5 cloths in the head.	After-leech	-	14	6
7 cloths in the foot.				
—			$\frac{1}{2}$)24	0
$\frac{1}{2}$)12 sum.			—	—
—			3)12	0 feet
6 square cloths.			—	—
4 yards, medium depth - - - -			4	yards
—				
24 yards, the product.				
3 “ in the gores and pieces.				
—				

Total, 27 yards.

SECTION SECOND.

CHAPTER I.

ON CUTTING-OUT SAILS.

All sails are cut-out, cloth by cloth.—Square-headed sails, the cloths in the centre are cut square to the depth.—The cloths which are cut slope-wise, or goring, ought to be numbered 1, 2, 3, &c., for preventing mistakes when bringing the cloths together.—How to cut the leeches of courses, topsails, &c.—Rule for finding the depth of the leech-gores, when the leeches are cut straight.—When the leeches of topsails are cut hollow, how to calculate the gores.—Fore-and-aft sails, where to commence to cut them.—Sails that have bonnets.—Table: showing the length of the gores, corresponding to the depth of the selvage, with the eating-in of seams.—Use of the table.—Practical examples.

SAILS are cut out, cloth by cloth, to the respective number of cloths in the head, foot, and stay: the depth, to the height of the mast, or leech. In sails denominated

TRANSVERSE, OR SQUARE-HEADED SAILS,

such as courses, topsails, topgallant-sails, and other four-sided sails, the cloths in the centre are cut square to the depth. The first square cloth cut, is the guide or regulator to cut all the other squares by; and, to prevent any mistake, *a mark may be put on it*. From each side of the square cloths cut, the gores are cut to give the roach on the foot.

Every cloth gored should be numbered from the squares, the first gore (1), and the succeeding cloths cut by it (2), (3), (4), &c., to avoid confusion and mistake in the sewing of the cloths together.

In cutting the leeches, the foot gore is cut first on the canvass, and the length of the longest selvage of the head-earing cloth serves to measure the shortest selvage on the canvass; and the first leech-gore is set down from a thread of the *weft* with the opposite selvage. The canvass being cut diagonally, the one gore cuts the gore for the other leech, the longest selvage

serving to measure its length, having the same gore cut on the foot. The gore left on the canvass is altered (if necessary) to meet the increased gore ; and the length of the shortest selvage of the first leech-gore serves to measure the shortest selvage on the canvass, and the gore set down as before, from the thread of the weft with the opposite selvage. The gore cut through, the two long gores, or points, are put together, and measured both of the same length, and having the same foot-gore cut. Consequently, one gore cuts the other, for both sides of the sail, without waste.

It is necessary to remember, when cutting the gores, that an allowance for the width of seam has to be made, because it is evident that the longest gored cloth must be longer than from the selvage to which it is sewed to the other selvage, since it is doubled at the seam ; and the overshoot from the end of the crease will be according to the depth of the gore.

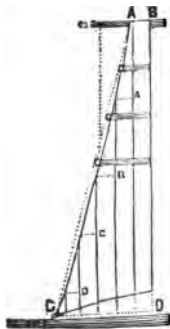
The depth of the leech-gores can be calculated, whether they require to be hollow or straight, and the sail cut right out, without requiring to be spread on the floor, which is the practice amongst some sailmakers of the present day.

The gores on the leeches, or appendages, when straight, are found by dividing the depth of the sail by the number of cloths gored in the leech, which gives the length of each gore, thus :—

Given the hoist of a topsail, 32 feet, and three and three-quarters cloths on each leech ; that is, half of a cloth at each earing, and one quarter of a cloth at the clues ?

$$\begin{array}{r}
 \text{FT.} \\
 \text{Here - Divide by } 3\frac{3}{4}) 32 \\
 \underline{4 \quad 4} \\
 15 \overline{) 128} \text{ (8 feet 8 inches.} \\
 \underline{120} \\
 8 \\
 \underline{12} \\
 15 \overline{) 96} \text{ (6} \\
 \underline{90} \\
 6 \\
 \underline{1}
 \end{array}$$

	FT.	IN.
And - - - - - Divide by $\frac{1}{2}$)	8	6
First, half a cloth - - - - -	4	3 gore.
Second, a whole cloth - - - - -	8	6 "
Third, ditto ditto - - - - -	8	6 "
Fourth, ditto ditto - - - - -	8	6 "
Fifth, a quarter cloth - - - - -	2	3 "
Leech - - -	32	0



The plan of the gored side of a topsail is made by first drawing a line B D to represent the depth of the sail, taken from a convenient scale of equal parts of an inch to a foot, and at right angles to B D, draw A B and C D equal to the widths of the cloths gored. Join A and C, and set down the close-reef at 18 inches above the centre of A C, and between it and the earing A, the other reefs. Through the breadth at the close reef and each extremity, pass the arc of a circle. Divide the base C D, which is equal to the width of the cloths, into as many equal parts as there are cloths in the leech; and at the points of division draw lines perpendicular to

C D to meet the curved leech, (from which the length of every gore to the scale of dimensions may be found with precision,) as in the perpendiculars of the small right-angled triangles A, B, C, and D, shown on the sketch.

Sails gored with a sweep on the head and foot, or foot only, have received the name of

FORE-AND-AFT SAILS,

such as mainsails, mizens, drivers, jibs, gaff topsails, &c. The first cloth next the mast-leech is cut first. Thus, the foot-gore is cut upon the end of the canvass, and the length of the tack-gore is measured up the short side on the selvage, and carried across by a thread of the web to the opposite selvage, and cut diagonally; then the longest gored side of the first cloth measures the length of the shortest side of the next. The canvass is again taken across by a thread, and the length of the second foot-gore is measured down on the opposite selvage, and cut diagonally; consequently, the first gored cloth being cut, the longest selvage of it serves to measure the shortest selvage

of the next, and so on, until the whole of the cloths in the mast-leech are cut to the given number, and its length, when care must be taken that the whole of the gores do not exceed the depth of the luff; and it is better to repeat the measures, to see whether they will make up the length, before proceeding with cutting the head cloths, even if the gores should all be rightly calculated.

In cutting all fore-and-aft sails, a long gore and a short gore are always brought together, and the breadth of the seams of the sail allowed for eating-in seaming.

The additional parts of sails, made to fasten with lutchings to the foot of the sails, and which are exactly similar to the foot of the sails they are intended for, constitute

SAILS THAT HAVE BONNETS,

such as jibs, drivers, &c., in lieu of having one or two reefs in the sail. The bonnets are cut out the whole depth of the sail, allowing enough for the tablings on the foot of the sail, and head and foot of the bonnet; then, after the sail is sewed together, the bonnet is cut off the depth required, generally 9 feet. Bonnets have a head tabling, $2\frac{1}{2}$ inches broad, on which a line of 12-thread, named *keel-line*, for forming the lutchings, is sewed in bights. These latches are six inches asunder, and six inches long, except the two middle ones, which are eighteen inches long, to fasten off with. In fastening it, the loops are alternately reeved through holes in the foot of the sail, and through each other, and fastened by the two long loops in the middle with two half-hitches, by the loosening of which they unreeve themselves. The tabling on the foot of the jib, when the bonnet is cut off, is six inches wide. The holes are wrought up from the edge close to the tabling stitches, the same distances as are the length of the lutchings. Also, the leech, foot, and stay are tabled, roped, &c., similar to the jib the bonnet is intended for. A strengthening band extends from the clue over two cloths less than half the number of cloths in the foot. Earrings are made on the head of the bonnet, six inches short of the top part, for attaching it to the clue and tack cringles of the sail.

For the length of gores corresponding to the depth on the selvage of canvass, 24 inches wide, observe the table on the two following pages, which will be found useful in finding the length on the stay of a jib, or the length of the mast-leech of a fore-and-aft mainsail; and, when the gores are cut longer, for the eating-up in seaming.

Depth down the Selvage		Length of the Gore.	Length of the Eating-in Seaming on the Selvage according to the Width of the Seams.													
			In. 1	In. 1½	In. 1½	In. 1½	In. 2	In. 2½	In. 2½	In. 2½	In. 3	In. 3½	In. 3½	In. 3½	In. 4	
Ft. In.	Ft. In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.		
0 1	2 0	0	0	0	0	0	0	0	0	0	0	0	0	½		
0 2	2 0	0	0	½	½	½	½	½	½	½	½	½	½	½		
0 3	2 0½	½	½	½	½	½	½	½	½	½	½	½	½	½		
0 4	2 0½	½	½	½	½	½	½	½	½	½	½	½	½	½		
0 5	2 0½	½	½	½	½	½	½	½	½	½	½	½	½	½		
0 6	2 0½	½	½	½	½	½	½	½	½	½	½	½	½	½		
0 7	2 0½	½	½	½	½	½	½	½	½	½	½	½	½	½		
0 8	2 1½	½	½	½	½	½	½	½	½	½	1	1	1½	1½		
0 9	2 1½	½	½	½	½	½	½	½	½	1	1½	1½	1½	1½		
0 10	2 1½	½	½	½	½	½	½	½	1	1½	1½	1½	1½	1½		
0 11	2 2½	½	½	½	½	½	½	1	1½	1½	1½	1½	1½	1½		
1 0	2 2½	½	½	½	½	1	1½	1½	1½	1½	1½	1½	1½	2		
1 1	2 3½	½	½	½	½	1	1½	1½	1½	1½	1½	1½	2	2½		
1 2	2 3½	½	½	½	1	1½	1½	1½	1½	1½	1½	2	2½	2½		
1 3	2 4½	½	½	½	½	1	1½	1½	1½	1½	2	2½	2½	2½		
1 4	2 4½	½	½	1	1½	1½	1½	1½	1½	2	2½	2½	2½	2½		
1 5	2 5½	½	½	½	1	1½	1½	1½	1½	2	2½	2½	2½	2½		
1 6	2 5½	½	½	½	1½	1½	1½	1½	2	2½	2½	2½	2½	3		
1 7	2 6½	½	1	1½	1½	1½	1½	2	2½	2½	2½	2½	3	3½		
1 8	2 7	½	1	1½	1½	1½	1½	2	2½	2½	2½	3	3½	3½		
1 9	2 7½	½	1	1½	1½	1½	2	2½	2½	2½	2½	3	3½	3½		
1 10	2 8½	½	1½	1½	1½	2	2½	2½	2½	2½	3	3½	3½	3½		
1 11	2 9½	½	1½	1½	1½	2	2½	2½	2½	2½	3	3½	3½	3½		
2 0	2 10	1	1½	1½	1½	2	2½	2½	2½	3	3½	3½	3½	4		
2 1	2 10½	1	1½	1½	1½	2	2½	2½	2½	3½	3½	3½	4	4½		
2 2	2 11½	1	1½	1½	1½	2½	2½	2½	2½	3½	3½	3½	4	4½		
2 3	3 0½	1½	1½	1½	1½	2½	2½	2½	3	3½	3½	4	4½	4½		
2 4	3 1	1½	1½	1½	2	2½	2½	2½	3½	3½	3½	4	4½	4½		
2 5	3 1½	1½	1½	1½	2½	2½	2½	3	3½	3½	3½	4½	4½	4½		
2 6	3 2½	1½	1½	1½	2½	2½	2½	3½	3½	3½	4	4½	4½	5		
2 7	3 3½	1½	1½	1½	2½	2½	2½	3½	3½	3½	4½	4½	4½	5½		
2 8	3 4½	1½	1½	2	2½	2½	3	3½	3½	4	4½	4½	5	5½		
2 9	3 5	1½	1½	2	2½	2½	3	3½	3½	4½	4½	4½	5½	5½		
2 10	3 5½	1½	1½	2½	2½	2½	3½	3½	3½	4½	4½	4½	5½	5½		
2 11	3 6½	1½	1½	2½	2½	2½	3½	3½	4	4½	4½	5½	5½	5½		
3 0	3 7½	1½	1½	2½	2½	3	3½	3½	4½	4½	4½	5½	5½	6		

Depth down the Sel-vage.	Length of the Gore.	Length of Eating &c.		Depth down the Sel-vage.	Length of the Gore.	Length of the Eating, &c.			Depth down the Sel-vage.	Length of the Gore.	Length of Eating, &c.	
		In. 1	Ins. 1½			In. 1	Ins. 1½	Ins. 1½			In. 1	Ins. 1½
Ft. In.	Ft. In.	Ins.	Ins.	Ft. In.	Ft. In.	Ins.	Ins.	Ins.	Ft. In.	Ft. In.	Ins.	Ins.
3 1	3 8½	1½	1½	6 1	6 4½	3	3½	4½	9 1	9 3½	4½	5½
3 2	3 9½	1½	2	6 2	6 5½	3	3½	4½	9 2	9 4½	4½	5½
3 3	3 10½	1½	2	6 3	6 6½	3	3½	4½	9 3	9 5½	4½	5½
3 4	3 11½	1½	2	6 4	6 7½	3½	3½	4½	9 4	9 6½	4½	5½
3 5	4 0	1½	2½	6 5	6 8½	3½	4	4½	9 5	9 7½	4½	5½
3 6	4 0½	1½	2½	6 6	6 9½	3½	4	4½	9 6	9 8½	4½	5½
3 7	4 1½	1½	2½	6 7	6 10½	3½	4	4½	9 7	9 9½	4½	6
3 8	4 2½	1½	2½	6 8	6 11½	3½	4½	5	9 8	9 10½	4½	6
3 9	4 3½	1½	2½	6 9	7 0½	3½	4½	5	9 9	9 11½	4½	6
3 10	4 4½	1½	2½	6 10	7 1½	3½	4½	5½	9 10	10 0½	4½	6½
3 11	4 5½	1½	2½	6 11	7 2½	3½	4½	5½	9 11	10 1½	4½	6½
4 0	4 6½	2	2½	7 0	7 3½	3½	4½	5½	10 0	10 2½	5	6½
4 1	4 7	2	2½	7 1	7 4½	3½	4½	5½	10 1	10 3½	5	6½
4 2	4 7½	2	2½	7 2	7 5½	3½	4½	5½	10 2	10 4½	5	6½
4 3	4 8½	2½	2½	7 3	7 6½	3½	4½	5½	10 3	10 5½	5½	6½
4 4	4 9½	2½	2½	7 4	7 7½	3½	4½	5½	10 4	10 6½	5½	6½
4 5	4 10½	2½	2½	7 5	7 8½	3½	4½	5½	10 5	10 7½	5½	6½
4 6	4 11½	2½	2½	7 6	7 9½	3½	4½	5½	10 6	10 8½	5½	6½
4 7	5 0½	2½	2½	7 7	7 10	3½	4½	5½	10 7	10 9½	5½	6½
4 8	5 1½	2½	2½	7 8	7 11	3½	4½	5½	10 8	10 10½	5½	6½
4 9	5 2	2½	3	7 9	8 0	3½	4½	5½	10 9	10 11½	5½	6½
4 10	5 2½	2½	3	7 10	8 1	3½	4½	5½	10 10	11 0½	5½	6½
4 11	5 3½	2½	3	7 11	8 2	3½	5	5½	10 11	11 1½	5½	6½
5 0	5 4½	2½	3½	8 0	8 2½	4	5	6	11 0	11 2½	5½	6½
5 1	5 5½	2½	3½	8 1	8 3½	4	5	6	11 1	11 3	5½	6½
5 2	5 6½	2½	3½	8 2	8 4½	4	5	6½	11 2	11 4	5½	7
5 3	5 7½	2½	3½	8 3	8 5½	4½	5½	6½	11 3	11 5	5½	7
5 4	5 8½	2½	3½	8 4	8 6½	4½	5½	6½	11 4	11 6	5½	7
5 5	5 9	2½	3½	8 5	8 7½	4½	5½	6½	11 5	11 7	5½	7½
5 6	5 10	2½	3½	8 6	8 8½	4½	5½	6½	11 6	11 8	5½	7½
5 7	5 11	2½	3½	8 7	8 9½	4½	5½	6½	11 7	11 9	5½	7½
5 8	6 0	2½	3½	8 8	8 10½	4½	5½	6½	11 8	11 10	5½	7½
5 9	6 1	2½	3½	8 9	8 11½	4½	5½	6½	11 9	11 11	5½	7½
5 10	6 2	2½	3½	8 10	9 0½	4½	5½	6½	11 10	12 0	5½	7½
5 11	6 3	2½	3½	8 11	9 1	4½	5½	6½	11 11	12 1	5½	7½
6 0	6 4	3	3½	9 0	9 2½	4½	5½	6½	12 0	12 2	6	7½

USE OF THE FOREGOING TABLE.

The foregoing table being the groundwork of the whole practice of cutting-out sails, the reader will do well to make himself perfectly familiar with it, as, without the calculations laid down therein being well observed, no sails or parts of sails, in which there is a large amount of gore, can be properly cut. Let it be required, for instance, to find the amount of the foot-gores in the mizen, as sketched on page 10. If we take the foot-gore G S, without making any allowance for the eating-in of seaming, the length will not be sufficient to give the proper foot-gore, as the seaming will shorten the diagonal and foot-gore, thereby making the sail to girt from the throat to the clue. Hence, an augmentation has to be made to the foot-gore G S on the drawing for the eating-in of seaming, as indicated by the gores in the table.

In the first column, find the depth given, and the second column will show the corresponding length; and, immediately under the width of the seam, and in a line with the gore, is the length of the eating-in seaming, or what the gore flies beyond the creasing of the seam. Suppose the depth to be 6 feet 4 inches, and the width of the seam $1\frac{1}{2}$ inches, opposite to it and under the width of the seam will be found 6 feet $7\frac{5}{8}$ inches and $4\frac{3}{4}$ inches respectively.

This table will be found of great use when cutting out a jib, beginning at the tack. The breadth of the seam on the foot requires to be allowed for before the gore is cut, and the quantity of inches corresponding to the gore is found under the width of the seam in the table. Thus:—Suppose the foot-gore is 1 foot 10 inches, and the seam $3\frac{1}{2}$ inches broad, then, under $3\frac{1}{2}$ inches is found 3 inches, to be measured on the canvass before the gore is set up on the opposite selvage.

It is also well adapted for ascertaining the exact length on the stay and leech of a jib, the mast of a driver, and luff of a gaff-topsail. Rules:—1. Place in parallel columns the depths of the gores on the stay and foot, and, opposite to them, the lengths of the gores and eating-in of the seaming, found in the table in different columns parallel to the former.—2. Add up the several columns, subtract the sum of the foot-gores from the sum of the depth of the stay-gores, and 18 inches for tabling gives the *length of the leech*.—3. For the length on the stay, subtract the sum of the eating-in of the seaming on the stay from the sum of the lengths of the stay-gores, and then

subtract 18 inches for tabling from the remainder.—4. For the mast of a driver, subtract the sum of the eating-in of the seaming from the sum of the lengths of the mast-gores, and 8 inches for tabling gives the *length on the mast*.

The following examples will practically exemplify the use of the table :—

Jib, 15 cloths. Leech, 46 feet 6 inches tabled. Stay, 67 feet 8 inches tabled.						Gaff-top-sail, 13 cloths. Leech, 32 feet 6 inches tabled. Mast, 49 feet tabled.					
Number of Cloths.	Depth of Stay Gores.	Depth of Foot Gores.	Length of Stay Gores.	Length of Eating-in of Seaming		Number of Cloths.	Depth of Mast Gores.	Depth of Foot Gores.	Length of Mast Gores.	Length of Eating-in of Seaming	
				1 inch Seam on the Stay.	1½ to 3½ in. Seam on the Foot.					1 inch Seam on the Mast.	1½ to 3 in. Seam on the Foot.
1	11 6	4	11 8	5½	11	1	6 0	0	6 4	3	0
2	5 6	5	5 10	2½	5	2	5 0	1	5 4	2½	0
3	4 7	6	5 0½	2½	4	3	4 0	2	4 6	2	0
4	4 3	7	4 8½	2½	3	4	3 6	3	4 0½	1½	0
5	4 0	8	4 6½	2	2	5	3 3	4	3 10½	1	0
6	3 10	9	4 4½	1½	1	6	3 0	5	3 7	1½	0
7	3 8	10	4 2½	1½	1	7	3 0	7	3 7	1½	0
8	3 6	11	4 0½	1½	1	8	3 0	9	3 7	1½	1
9	3 5	12	4 0	1½	1	9	2 9	12	3 5	1	1
10	3 4	13	3 11½	1	1	10	2 9	15	3 5	1	1
11	3 4	15	3 11½	1	1	11	2 9	18	3 5	1	2½
12	3 3	17	3 10½	1	2½	12	2 9	21	3 5	1	2½
13	3 3	19	3 10½	1	2½	13	2 9	24	3 5	1	2½
14	3 3	21	3 10½	1	3						
15	3 3	24	3 10½	1	3						
Total.	63 11 2 6	181 17½	71 8½ 2 6	12½	30 2 6	Total.	44 6 1 9	121 10½	52 1½ 1 9	12½	21 1 9
	61 5 13 7½=133½		69 2½ 1 6 tablings.				42 9 9 2½=110½		50 5 1 3 tablings.		
	47 9½ cut 1 6 tablings.		67 8½ tabled—stay.				33 6½ 1 0 tablings.		49 2 tabled—mast.		
Leech	46 3½ tabled					Le ch	32 6½ tabled.				

* * The length of the after-leech of fore and aft mainsails, drivers, &c., is found by adding the depths of the mast, foot, and head-gores, and slack seams together, and deducting from their sum the eating-in of seaming of the mast and foot gores

CHAPTER II.

GENERAL RULES AND INSTRUCTIONS FOR MAKING SAILS.

The Materials used:—Canvass—the best Canvass—the different sorts, distinguished by numbers.—Selecting Canvass.—Twine, spun of the best flax.—**Making of Sails:**—Seams, Tablings, &c.—Linings.—Holes and Grommets.—Bolt-Rope, the method by which it ought to be made.—Bolt-Rope Table.—Rules for finding the number of Threads or Yarns that go to make a Rope.—To find the Weight of One Fathom of any sized Rope.—To find what Length one fathom of Rope stretches, as it comes down in size.—Table of the Circumference, in inches, of Bolt-Rope, for Sails for Ships, Barques, &c.—Bolt-rope, sewing it on.—Clues.—Iron Clues.—The advantages of Cringles over turned Clues.—Cringles:—Earing Cringles, Reef and Reef-Tackle Cringles, Points, Bowline Cringles.—Splices.—Lengthening a Rope with One Strand.

THE MATERIALS—CANVASS, &c.

Canvass.—To obtain the best canvass for the making of sails is of the first importance to the shipowner, not only on account of the great expense of sails, but because the safety of a ship, in tempestuous weather, frequently depends on its quality; and, besides, the cost for making is not more for a good article than it is for a very bad one. Hence, the best canvass is by far the cheapest in the end. The canvass which is generally used in the merchant service, is *twenty-four* inches wide, and it is certainly the strongest for all purposes. Sometimes, however, jibs and drivers are made of *eighteen* inches wide canvass, to ensure greater strength and a better appearance.

There are six to eight (and some lighter) sorts of flax canvass, viz.:—Nos. 1, 2, 3, 4, 5, 6, 7, and 8, which ought to weigh respectively 46 lb., 43 lb., 40 lb., 37 lb., 34 lb., &c., per bolt of 40 yards each. The warp or chain of every piece or bolt of the first three numbers should be wholly wrought, and made of double yarn, and contain, in every piece or bolt of 24 inches wide, at least 560 double threads of yarn; and both the warp, and shoot or weft yarn, ought to be made of long flax, without any mixture of tow, and this of strong staple, fresh, sound, and good of its kind. It should also be well dressed, properly cleansed, even spun, and well twisted; and all the weft yarn should be fully as strong as the warp yarn, and close struck.

In selecting canvass for making up into sails, considerable practice and close observation are required, as well as a general acquaintance with the manufacture of canvass. The experienced sailmaker forms his opinion of the quality and strength of canvass, not only from its being even spun and well struck together, but he takes two persons' canvass, of the same No., and makes a slit in each, and knots them together; he then hangs weights to the loose parts, and finds which bears the most. Another trial is by boring a *fid* through the canvass, when the threads of bad canvass are easily broken; and the workman can tell the difference in this way, when working holes in a sail. A testing machine is also an excellent plan. Again, for knowing the quality, draw a few threads, and examine whether they are composed of long flax, without mixture of tow, and try if it be of strong staple, fresh, sound, and well cleansed.

It is of importance for canvass to have a good and even selvage, and free from tightness, because of the seaming, which it is awkward to have slack in seams unnecessarily. It may, however, be observed, that the varieties of canvass differ greatly in the amount of their stretch. Generally, canvass badly struck together stretches most.

Twine.—The edges of the cloths or pieces of which a sail is composed, are sewed together with a double seam, and should be sewed with the best twine (made of flax), of three folds, spun from 360 fathoms to 430 fathoms to the pound; and one pound of twine will sew four bolts of canvass, or 160 yards in length. The twine for large sails, in the royal navy, is waxed by hand, with genuine bees'-wax, mixed with one-sixth part of clear turpentine, in sails made of Nos. 1, 2, 3, and 4; and, for Nos. 5, 6, 7, and 8, twine dipped in a composition of bees'-wax 4lb., tallow 5lb., and clear turpentine 1lb. The roping twine is all dipped in the composition. In the merchant service, the twine is dipped in tar, softened with a proper proportion of oil.

MAKING OF SAILS :—SEAMS.

The *seams* of sails are generally sewed twice from the foot to the head—that is, the selvage of one cloth is sewed to the edge of the other, turned in to the required breadth (see page 13); and, when finished, it must be well pressed down with a “rubber,” and turned over to sew the second side, and again rubbed down. Some prefer sticking or stitching the second

side of the seam, in order to save the stitches from chafing—the stitches of a round seam standing high; but it is to be observed, two round seams are much stronger than a round and a flat seam. The distance of the stitches must be regulated according to the strength and quality of the canvass. In new sails, the stitches are from one hundred and twenty-four to one hundred and forty-four stitches in every yard in length; but in repairing old sails, few stitches are required.

In the royal navy, sails made of canvass Nos. 1, 2, 3, and 4 are middle-stitched; but the other numbers are not.

The *creasing of seams* is a very important thing in fore and aft sails, and requires good judgment. The *breadth* of the seams on the foot of a jib or driver ought to be made according to the roach with which the sail is cut, and thus eat up the irregular gores, so as to form a regular curve on the foot. The *length* run up from the foot should be for a jib at the clue thus— $3\frac{1}{2}$ inches broad by 3 feet up, next $4\frac{1}{2}$ feet, 5 feet, and 6 feet the rest: the remaining breadths at the foot gradually narrowed to 2 inches. Driver seams are thus, viz.— $3\frac{1}{2}$ inches broad, and run up 2 feet, 3 feet, $4\frac{1}{2}$ feet, $5\frac{1}{2}$ feet, and 6 feet the mast part; and 3 inches broad, by 2 feet, 4 feet, $5\frac{1}{2}$ feet, and 6 feet from the foot and the leech, and continued 3 inches broad and 6 feet up between the leech and mast; also, at the head, when not cut straight, $2\frac{3}{4}$ inches broad, decreasing to the peak to $2\frac{1}{2}$ inches, and creased down 4 feet: the remaining part of the seam $1\frac{1}{2}$ inches broad.

TABLINGS.

The *widths* of the tablings of all sails are according to the size of the sail, and stuck or stitched down on the edge or on the top (long-work), with 72 to 110 stitches in a yard. (For widths, see page 13.)

The *breadths* of the tablings of fore and aft sails, such as jibs and drivers, are thus:—*Jib*, a 3 inches tabling on the *leech* and the stay; $2\frac{1}{2}$ inches, doubled into the rope or bite of the canvass, the *foot*. The *leech* tabling is sometimes banded or doubled again. *Driver*.—The *leech* tabling is made broader at the clue and peak, to make the leech round, and keep the corners in proper form: the remaining part of the leech tabling about $3\frac{1}{2}$ inches wide. The *head* and *mast* tablings are from 4 to 5 inches wide; and the *foot* $2\frac{1}{2}$ inches—like the jib, or rather narrower.

LININGS.

All linings are generally seamed on the sails, except the reef-bands, which are tabled on the fore-side, and top-linings, mast-cloths, and corner-pieces seamed on the after-side of the sail ; and, when there is not a middle-band on the top-sail, the reef-tackle pieces are seamed on the after-side, and reach the top of the top-lining.

It may be necessary to observe, that linings ought not to be put on too taut, or flat ; they require to be put on *easy*, as they are generally of lighter canvass than the sail, and not capable of bearing the same strain as the sail ; besides they run up a great deal by wet.

HOLES AND GROMMETS.

Holes are cut by a knife, and stretched or rounded up by a fid or a marline spike, and are fenced round by stitching the edge of the hole to a *grommet*, made like a ring, of three strands, with rope-yarns ; when finished, they should be well stretched.

The holes in sails have received particular names ; as, head, reef, cringle, bowline, clue-cringle, clue-garnet, bunt-line, spilling, bunt-jigger holes, &c., all of which are hereinafter mentioned.

Sails have the holes in the heads and reefs of topsails, courses, &c., placed thus :—One hole is made near the seam on each side of the middle cloth, or two holes in the cloth and one in the next, on both sides ; and so on, one and two holes, from the middle ; and in the centre of the head is stuck a small cringle, for making the middle fast, and for serving as a guide in bending the sail square to the yard. Holes in the stays of jibs, staysails, &c., are one yard apart, excepting at the peak, when the hole is about 2 feet distant.

Reefs and *head-holes* of large sails have grommets of bolt-rope yarns, made thick in the rim, and worked round with 18 to 21 stitches. Small sails have grommets of small bolt-rope yarns, worked with 16 to 18 stitches, or as many as will cover the grommet. Holes ought not to be larger than what is necessary for the points getting through. Clue and buntline holes are the largest in the sail, to admit the rope or cringles passing through them.

In the royal navy, the large sails have two holes in each cloth in the reefs of courses, and third and fourth reefs of the topsails ; and, also, in the trysails.

BOLT-ROPE.

Bolt-rope should be well made of fine yarn, spun from the best Riga Rhine hemp, well topped, and tarred in the best Stockholm tar. It is the erroneous practice of some ropemakers, in the closing of the strands, to have too much tension on the strands, which causes the rope to be hard to sew on. There is no necessity for this. The hard-stranded and flexible rope will last longer than the hard-closed rope, which will generally break before it bends, and wears badly.

The following table shows the weight of one fathom of rope, from $\frac{3}{4}$ of an inch to 8 inches in circumference; and, also, the number of yarns in each strand, and number of threads of twine for sewing the bolt-rope on to the sails:—

Size of the Bolt-rope in inches.	Number of Yarns in each Strand.	Weight per Fathom.	Threads to sew them on.		Size of the Bolt-rope in inches.	Number of Yarns in each Strand.	Weight per Fathom.	Threads to sew them on.	
			Ord*	Ext.				Ord*	Ext.
$\frac{3}{4}$	2	0 2	2	0	$4\frac{1}{2}$	56	4 5 $\frac{1}{2}$	8	0
1	3	0 3 $\frac{1}{2}$	2	0	$4\frac{3}{4}$	62	4 13 $\frac{1}{2}$	8	0
$1\frac{1}{4}$	5	0 5 $\frac{1}{2}$	2	0	5	69	5 6	8	2
$1\frac{1}{2}$	7	0 7 $\frac{1}{2}$	2	0	$5\frac{1}{4}$	76	5 15	8	2
$1\frac{3}{4}$	9	0 10 $\frac{1}{2}$	2	0	$5\frac{1}{2}$	84	6 8	10	0
2	11	0 14	2	2	$5\frac{3}{4}$	91	7 2	10	0
$2\frac{1}{4}$	14	1 1 $\frac{1}{2}$	2	2	6	100	7 12	10	2
$2\frac{1}{2}$	17	1 5 $\frac{1}{2}$	4	0	$6\frac{1}{4}$	108	8 6 $\frac{1}{2}$	10	2
$2\frac{3}{4}$	21	1 10	4	0	$6\frac{1}{2}$	117	9 1 $\frac{1}{2}$	12	0
3	25	1 15 $\frac{3}{4}$	4	2	$6\frac{3}{4}$	126	9 13	12	0
$3\frac{1}{4}$	29	2 4	4	2	7	136	10 8 $\frac{3}{4}$	12	2
$3\frac{1}{2}$	34	2 10	6	0	$7\frac{1}{4}$	146	11 5	12	2
$3\frac{3}{4}$	39	3 0 $\frac{1}{2}$	6	0	$7\frac{1}{2}$	156	12 1 $\frac{3}{4}$	14	0
4	44	3 7	6	2	$7\frac{3}{4}$	166	13 0	14	0
$4\frac{1}{4}$	50	3 14	6	2	8	177	13 12 $\frac{1}{2}$	14	2

* By ordinary and extra is meant roping and seaming twine.

The table given above is calculated by the usual mode adopted by ropemakers, and is termed by them *working by the square*. The following are some of the rules in use for finding the number of yarns in each strand.

Cable-laid :—Size, 16-thread yarn.

RULE.—Square the size of the rope proposed to be made, and half the product will give the number of threads or yarns to work per hook, in all sizes of three-strand cable-laid cordage, of 16-thread yarn.

Shroud-laid :—Size, 18-thread yarn.

RULE.—Square the size of the rope, as before, and twice the product will give the number of threads to work per hook, in all sizes of three-strand shroud-laid of 18-yarn.

Shroud-laid :—Size, 25-thread yarn.

RULE.—Square the size of the rope, multiply that product by 25, and divide by 9, the quotient will be the number of threads to lay up per hook, which answers to 25-thread yarn, in all sizes of bolt-rope, as per table. Thus:—A 5-inch rope? The square of 5 is 25, which multiplied by 25 is 625, and divided by 9 gives 69, for the number of threads to work per hook.

To find the Weight of one Fathom of any sized Rope?

RULE.—Square the size of the rope, multiply that product by the weight of one fathom of 3-inch rope, and divide by 9, the quotient will give the weight of any sized rope demanded, thus:—The weight of a 4-inch rope? The square of 4 is 16, and 16 multiplied by 31 (the weight of one fathom, in ounces, of a three-inch rope in the table,) is equal to 496, which, divided by 9, gives $55\frac{1}{9}$ oz., or 3lb. 7 oz., the weight of a 4-inch rope. (See table.)

To find what length one fathom of rope stretches, as it decreases in size.

RULE.—Square the size of the rope, multiply that product by 6, and divide by the square of the reduced size of the rope, the quotient will give what length one fathom has stretched. Thus:—Suppose a fathom of 4-inch rope to be stretched until its diameter is reduced to $3\frac{1}{2}$ inches; what length is it? Here the square of 4 is 16, which, multiplied by 6, equals 96, and divided by the square of $3\frac{1}{2}$, or $\frac{49}{4}$, gives 6 feet 10 inches. Hence it will have stretched 10 inches per fathom

EXAMPLE.

What slack canvass should be roped in the leech of a topsail, 27 feet 6 inches, when a $3\frac{1}{2}$ -inch rope is reduced to $3\frac{1}{4}$ -inch?

By the foregoing rule:—The square of $3\frac{1}{2}$, or 3.5, equals 12.25, which, multiplied by 27.5, and divided by the square of $3\frac{1}{4}$, gives 32 inches, or the slack required.

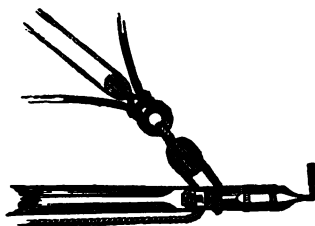
Table of the Circumference, in Inches, of Bolt-Rope for Sails of Ships, Barques, Brigs, Schooners, Cutters, and Boats.

SPECIES OF SAILS.	Tons. 1,000 to 1,000.				Tons. 900 to 700.				Tons. 600 to 500.				Tons. 400 to 350.				Brigs.			
	Rope.				Rope.				Rope.				Rope.				Rope.			
	Head or Stay.	Foot.	Fore-Leech.	After-Leech.	Head or Stay.	Foot.	Fore-Leech.	After-Leech.	Head or Stay.	Foot.	Fore-Leech.	After-Leech.	Head or Stay.	Foot.	Fore-Leech.	After-Leech.	Head or Stay.	Foot.	Fore-Leech.	After-Leech.
Main-course or Mainsail	24	54	54	54	24	54	54	54	24	54	54	54	24	54	54	54	24	54	54	54
Fore-course	24	54	54	54	24	54	54	54	24	54	54	54	24	54	54	54	24	54	54	54
Main-top-sail	24	54	54	54	24	54	54	54	24	54	54	54	24	54	54	54	24	54	54	54
Fore-top-sail	24	54	54	54	24	54	54	54	24	54	54	54	24	54	54	54	24	54	54	54
Mizen-top-sail	24	54	54	54	24	54	54	54	24	54	54	54	24	54	54	54	24	54	54	54
Main and Fore Topgallantsails	13	34	34	34	13	34	34	34	13	34	34	34	13	34	34	34	13	34	34	34
Main and Fore Staysails	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34
Fore-topmast-staysail	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34
Mizen-staysail	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34
Lower, Main, and Fore Top- mast-studdingsails	2	34	34	34	13	34	34	34	13	34	34	34	13	34	34	34	13	34	34	34
Mizen-topgal.-sail, Main & Fore Royals, and Topgal.-stud.-sails	14	24	24	24	1	14	14	14	1	14	14	14	1	14	14	14	1	14	14	14
Mizen-royal	1	2	2	2	1	2	2	2	1	2	2	2	1	2	2	2	1	2	2	2
Jib	24	34	34	34	24	34	34	34	24	34	34	34	24	34	34	34	24	34	34	34
Driver or Mizzen	24	14	14	14	24	14	14	14	24	14	14	14	24	14	14	14	24	14	14	14
Awlings	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
Flying-jib	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
Main-trysail	24	14	14	14	24	14	14	14	24	14	14	14	24	14	14	14	24	14	14	14

BOLT-ROPE :—SEWING IT ON.

The flexibility of *bolt-rope* should be always considered in taking in the slack, which must rest on the judgment of the sailmaker, and it should be neatly sewed on through every contline of the rope ; and to avoid getting a turn, the rope must be kept tightly twisted while sewing on ; but to rope without a turn in it, can only be acquired by practice. In roping, care must be taken that neither too much nor too little slack is taken in, but a regular slack held on all the way on the leeches of square sails. The leeches of fore and aft sails ought to be straight-roped, without any slack, with a shallow stitch and a stout thread. All jibs should be roped straight round the sail ; the foot-rope the slackest, when the foot is cut with a curve. On the foot of trysails, it is the erroneous practice of some sailmakers to curl the rope next the clue in sewing it on : all foot-ropes on drivers, trysails, &c., should be sewed on very round, and slack in the way of the gores, with a slight hold of the canvass, and for the canvass to carry the strain. Mast-ropes ought to be nearly straight roped on, and the head-lines one inch in every yard slack canvass. Many a well-cut sail is spoiled by the roping.

CLUES.



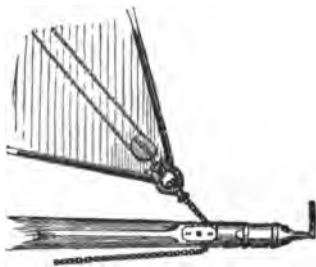
In the royal navy, the courses and topsails have short clues, with double thimbles, and the blocks strapped on, when fitted on board of ship, as shown in the sketch. The top-gallant clues have no thimbles. The *foot ropes* of courses and top-sails only, are served throughout—topgallant sails round the

clue, about one foot each way.

The *marling-holes* of courses, topsails, and clues of fore-and-aft sails, have from 11 to 13 stitches ; fourteen holes are worked in each cloth. The depth of the marling-holes of courses (for frigates) are at 3 inches from the rope ; and those of main and fore-topsails are at $2\frac{3}{4}$ inches, and mizen-topsail $2\frac{1}{2}$ inches, from the rope. Topgallant-sails and royals have no marling holes. The *clues* of ships' square-footed jibs are served and marled ; round-footed sails have cringles stuck through two holes, served,

and thimbled. All *tacks* are formed by an earing in the stay-rope, Thimbles of mixed metal are used in boats' sails, and in the buntline-holes of courses and topsails. Thimbles of iron in all other sails are used.

In the merchant service, the clues of courses, &c., are different from those of the royal navy. The rope is carried round the sail, without forming the clue, with a seizing, thus:—Rope clue-cringles are stuck through two holes with a thimble for the sheet, in the same manner as the reef-cringles; the sheet, by this mode having a fairer strain than by any seized clue.



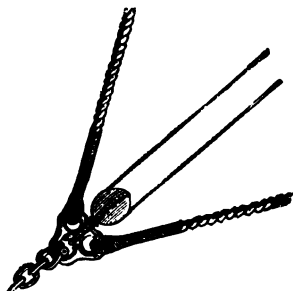
The *hole* for the clue garnet is worked close up to the clue-holes, and the clue-line block-strop reeves through the hole and clue-crinkle, and it therefore takes a direct strain from the sheet; the block is seized into the strop on the afterside with several turns of spunyarn, and strained tight with three or more cross-turns.

The advantage of rope clue-cringles in lieu of turned clues is, that they are more readily replaced when they break; besides, more sail is gained in not having long clues. The more compact clues can be made, the stronger they will be, and the clues will also come nearer to the sheave-holes in the yards, besides avoiding the complaint of "the clues always breaking." Hence care should be taken to ensure their being of sufficient strength, and made so as to last as long as the sail.

Recently, *iron* clues in place of rope have come much into fashion, and bid fair to supersede the use of the latter material altogether. The Americans fit *iron* clues in all their sails indiscriminately, both in fore and aft sails, as well as in courses, topsails, and topgallant-sails.

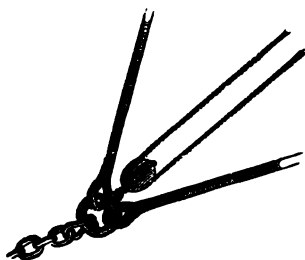
There are many captains who question the propriety of substituting iron for rope clue-cringles, because they do not like ironwork at all about their sails to iron-mould the canvass. Iron clues, however, are apparently stronger than rope, and last much longer, and when galvanized they may for a long time be preserved from rusting; and, it must be remembered, that when a sail is worn out, they can, by being galvanized afresh, be put into a new sail again.

These *iron* clues have two eyes with thimbles inserted for splicing to the bolt-rope. The round shape of the clue, and the position of the two eyes, give it the appearance of a pair of spectacles, and hence its name "the spectacle clue." The clue is formed by simply welding a round eye on each end of a bar of round iron, then bending the bar into a round shape, and bringing the sides of the two eyes together. Another eye is made by an open link welded over the parts of the eyes which meet together, and then bent through the clue-eye, into which a thimble is inserted, for stopping on the clue-line block.



The *eye splices* are made of an additional length of 15 to 18 inches of the bolt-ropes being left at the clue of the sail, which, being thrust through the eyes and over the thimbles respectively, are turned back to the size of the thimbles, and form the eyes; which being neatly covered with service-leather, the ends are stuck twice through and hove well in (with a heaver

and board); the clue is then set-up and the eye-splices well stretched, the ends are tapered, and laid along the rope, marled, parcellled, and served over with spun yarn; then marled round the corner of the clue of the sail as far as it is served.



The adjoining sketch is another form of iron clue, consisting of a large *ring*, into which three thimbles are inserted — two for splicing into the bolt-ropes, and the third, a small thimble for the clue-line block stop to splice into. These *ring-clues* are more approved of than the spectacles, for the eyes come closer together the tighter the clue is hauled

on, and there is less strain on the canvass at the corner of the clue of the sail.

Other improvements have been adopted by many sailmakers instead of those just mentioned, and the result has been to secure a more flexible rope at less expense without the aid of marling-work. *No* service should be put on any sail *except round the clue*.

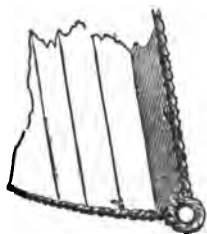
Roping and neat service-leather or two-fold canvass casing (in the way of chafes) are cheaper, lighter, less exposed, more flexible, and therefore easier for handling, consequently it is in every respect decidedly better.

The *clues* of *topgallant-sails* and *royals* are similar to those of topsails. The cringles are one-inch larger than the rope which goes round the sail. A hole for the clue-garnet is prepared, in every respect the same as the topsails. The clues only are parcelled with worn canvass, well tarred, and served over with two-yarn spun yarn, and marled in with strong marline as far as they are served. The clues of small royals are formed of the bolt-rope, sewed home to the clues. The clues only are served with spun yarn, and seized with houseline or marline.

The *clues* of *main*, *fore*, and *mizen staysails*, and *main* and *fore-topmast staysails*.—The cringles are half-an-inch larger than the clue-rope. The clue-rope splices into the foot and after leech-rope, and the cringle is stuck through holes made in the corner of the clue, and hitched. The ends of the cringle are passed through the bolt-rope three times each way, and the tacks have cringles stuck in the same manner as the clues, and earings at the peak, with iron thimbles in each of the corners.

The *clues* of all *studdingsails* have cringles stuck through holes, and the ends passed into the bolt-rope. The tacks only of topmast-studdingsails, topgallant-studding sails, &c., are made of the bolt-rope, parcelled, and served with spun yarn. The canvass is marled on to the rope about 18 inches, equally distant from the clue, or the extent of it served.

The *clues* of *ships' drivers* and *trysails*, *barques' mizens* and *trysails*, *brigs' mainsails*, &c.—These are made with cringles, about half-an-inch larger than the clue-rope. The mast-rope on the driver of large ships should be taken round the tack and neck; also, the peak-rope round the corner, and spliced in the head-rope; and cringles stuck in all the corners, with the ends passed into the bolt-rope. The tack of the driver should be strong, as it



is frequently hauled to the weather mizen rigging. The tacks of large jibs should have a rope spliced into the foot and stay-rope, as large as the clue-rope, with a cringle: the clues to be fixed about two feet equally distant from the clue, and the cringle half-an-inch less than the clue-rope, stuck twice through

the holes, and the ends passed into the cringle, or into the bolt-rope.

The *clues* of *sloops' topsails*, and *topsails* and *other sails* of *colliers*, are mostly formed by the rope going round the sail, which is left sufficiently long to form the clue.

Cringles should be made of the strands of new bolt-rope, half-an-inch smaller than the bolt-rope on the sail to which they are fastened, excepting the *clue-cringles*, which cannot be too strong.



The *earing-cringles* are made of an additional length of 15 to 18 inches of the leech-rope left at the head of the sails, which, being turned back to the size of eight twists or turns, forms the cringle by splicing its ends into the leech-rope, and cross-stitching the whole of the splice. The first stitch at the head is double, and all the cross-stitches hove tight. The ends of the head-line are spliced into the earings, and one strand is turned back and spliced in the head-rope, for preventing the head-line drawing out of the earings. All earings are served over with spun yarn, when finished.

Reef and *reef-tackle cringles* are stuck through holes made in the tablings, and the lower-ends are put through the bolt-rope once more than the upper ends, being more liable to be drawn out. Sometimes the cringles are stuck twice through the holes, and the ends worked up into the cringle. Eyelet-holes, thus worked in the sail for cringles to be formed through, are an excellent plan, as the cringle is then made round the entire rope, and not between the strands, which must give the leech-ropes better lead, and less injury to the rope.



Manilla reef-points are now generally used for sails in the merchant service, as they not only cost less, but, in point of utility, are preferable to the white-line points, being softer and and having a beautiful silky appearance, while at the same time in weight they are one-third less than the white-line: thus not only reducing the weight on a topsail, but also being easier for the men when tying the points in reefing. The lengths of the points are about twice the circumference of the yard. At each reef the points are lessened six inches in length; and the aft-legs

are one foot longer, excepting the close-reef points, which are halved. The points being whipped at each end, and inserted in the eyelet holes, they are fixed in the sail by sewing them to the upper part of the grommet on the after-side of the reef-band. In fore and aft sails, the points are sewed to the lower part of the grommet, "smack" fashion.

In the royal navy, the topsail reef-points are flat-braided or plaited with 3-yarn spunyarn, and made with an eye at one end, and whipped at the other. They are fixed in the sails by means of two knots, one of which is before and the other behind the reef-band, thus :—A running eye is made on each pair, and then greased, to make the eyes run easy ; the ends are thrust through the reef-holes, from the fore and after side, and rove in each other's eye, then jammed tight. while using sheaves to set the feet against.

The *bowline-cringles* of courses and topsails are stuck the same way as the reef-cringles ; and topgallant sails and royals are stuck in the bolt-rope on the sail, at the distance of four turns or one strand clear in the bolt-rope asunder. The ends are first stuck in an opening made with a fid, under two strands of the bolt-rope. The two ends are then passed over each other, one of them being the longest. The long end is thrust through two strands, and worked back into a three-stranded rope. The ends are then stuck under two strands, and again passing over one strand, and they are finally stuck under two : all bowline-cringles are served as those of earings.



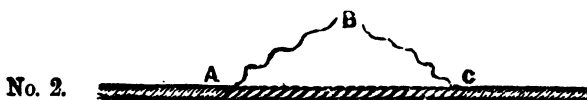
Splices are made by opening the ends of two ropes, and placing the strands between each other, openings being made in the untwisted part of the rope, near the thickest end, with a fid. The strands are thrust through them ; and the large ends are regularly tapered from the thick rope, by cutting away some of the yarns every time they are thrust through. The small strands, as those of the foot or leech rope, are stuck twice through the openings made in the large rope ; and the large strands are tapered on to the small rope for about 15 to 18 inches. The left-handed splices are the best for roping straight, and look much better, being passed to and keeping the form of the strands, and scarcely showing that there is a splice. All splices are cross-stitched as far as they run, and some only at the ends.

TO LENGTHEN A ROPE WITH A SINGLE STRAND.

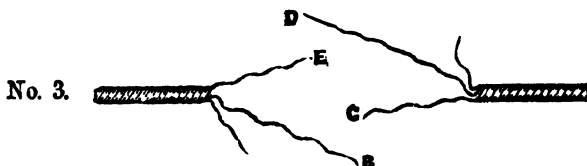
The plan of lengthening a rope, for the purpose of enlarging a sail with one cloth, instead of putting in a piece of rope and making two long splices, is this :—First, rip the rope off four cloths—



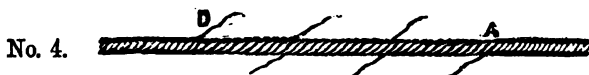
Cut a single strand at B for a centre, unlay each strand to A and to C 2ft. 6in. each way, forming No. 2 :—



Cut the next strand at C, and unlay it to A ; and finally cut the last strand at A ; thus forming No. 3 :—



Join B and C, lay up D and E, and it will form No. 4 :—



Lay in the single strand from A to D, and you will have four splices or knots.

This is also a good plan for shortening a rope in a fore-and-aft-sail, when too much slack-rope has been put on, and you have not enough rope to make a long splice : you can shorten it as little as 6 inches.

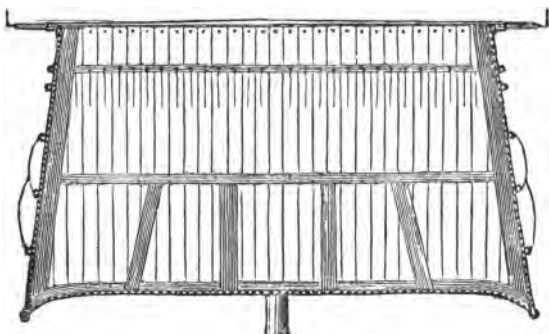
This is rather a troublesome splice to make if it is not laid-up right the first time ; but practice and keen observation soon overcome the difficulty.

CHAPTER III.

PRACTICAL OPERATIONS IN SAILMAKING.

Courses:—Main-Course:—Rule for determining the Depth of the Leech and Head—Dimensions for Cutting-Out—To determine the Size of a Square Mainsail for a Brig—Dimensions for Cutting-Out.—*Note.*—Rule for finding the Gore at the Top of Buntline Cloths, inclined inwards.—Reefing Courses to Jack-Stays.—Fore-Course:—Dimensions for Cutting-Out — Boom-Foresail — Ship's Cross-Jacksail—Topsails—Main, Fore, and Mizzen — Rule for determining the Hoist, Head, Close-Reef, and Foot. — Topgallant Sails:—Main, Fore, and Mizzen — Rule for determining the Hoist, Head, and Foot. — Royals:— Main, Fore, and Mizzen.—Rule for determining the Hoist, Head, and Foot.

MAIN-COURSE.



This sail is quadrilateral, square on the head, (some cut it down at the earings,) and is made of No. 1, 2, or 3 canvass. It bends at the head to the jackstay on the mainyard, which hangs to the mast at right angles, and parallel to the deck. The earings come 18 inches within each of the cleats on the yard-arms, and the middle of the foot-drops, to clear the height of the boat.

Gores.—One to two cloths are gored on the *leech*; and the gore on the *foot* equals the difference of the depths of the leech and middle. The roach, however, of the foot (of large courses) is *not* circular; three-fifths of its breadth at the middle is made parallel to the head, from which place the clues are carried

down to give the amount of roach, at the rate of so many inches per cloth. The reason why there are so many square cloths in the centre of this sail, is to prevent leeward pressure, thereby equalizing the pressure of the wind on the surface of the sail :—the same means clearing the height of the boats, and not throwing the foot so high up into the wind. (See page 8.)

The roach usually given to a main-course, in 1,500 ton ships, is 3 feet 9 inches, and in smaller ships, 5 to 7 feet. The depth of the *leech* is found, if for a new ship, by the following

RULE

Add the length of the mast-head, the slings below the bottom of the trestle-trees, the housing of the mast, and the chess-tree, or block hooked into eye-bolt, above the deck, the sum of which, subtracted from the extreme length of the mast, and 20 inches or 2 feet from the remainder, gives the *length of the leech*.

The *head*.—Subtract the two yard-arms from the whole length of the main-yard, which gives the hounded length, and 3 feet or 18 inches within each of the cleats on the yard-arms, for the *width on the head*. Thus :—

Main- mast, }	FT.	IN.	FT.	IN.		Main-yard	FT.	IN.
	77	3	12	6	head.	-	71	0
			4	6	sling.	" two arms	7	0
			19	9	housing.			
			2	0	chess-tree.	" hounded	64	0
			1	3	{ tack block	" within clts	3	0
					and shackle.			
	40	0				Head - - -	61	0
						or 33 cloths, per table		
						page 19.		
	37	3						
	1	3	Stretching					
	36	0	Leech					

DIMENSIONS FOR CUTTING-OUT.

	FT.	IN.	Foot-gores :—1, 2, 3, 4, 5,
Head - -	61	0	equal to 33 cloths.
Foot - -	65	8	equal to 37 cloths.
Leech - -	36	0	tailed.
Gore - -	4	0	Leech-gores, 18ft. 6in. each.
Middle -	33	0	cut, 19 squares.

Note—One foot is added to the middle for tabling.

For seams, tablings, reef and head holes, &c., see the general instructions at pages 40, 41, &c.

The main-course has, in very large ships, two *reef-bands*, of one-third the breadth of a cloth. The upper reef is 6 feet 6 inches, and the lower reef-band is 7 feet distant from the upper one. The ends go under the leech-linings to the rope, which are tabled twice down. Ships of 900 tons and under have only one reef-band, about 6 feet down from the head. The *reef-tackle cringle* is 3 feet below the reef. The sail has also a *middle-band*, of one breadth of cloth, half-way between the lower reef-band and the foot. It is first folded and creased down at one-third of the breadth, then tabled small (long) work on the top of the selvage; and it is then turned down, and seamed both the selvage and double part, leaving open in the way of the tops of the buntline cloths, to be stitched down twice underneath. Half a breadth middle-band is put on small courses, half-way between the reef-band and the foot.

Linings are of one breadth of cloth, from the clue to the earing on the leeches. The foot is lined from clue to clue with half a breadth of canvass.

Four *buntline cloths* are placed at equal distances between the clues, extending from the foot to underneath the lower side of the middle-band, which is tabled down upon the ends of the buntline cloths; and the feet of the buntline cloths are tabled down over the foot-band. The outer buntline-cloths are put on two cloths of the sail, goring inwards; and the middle two are straight up and down.* (See sketch, p. 53.) When there are four buntline-cloths in the sail, divide the foot into five equal parts; for two bunts, divide the foot into three parts. In small courses there are only two buntline-cloths, run up abor' one yard and a half.

Reef-cringles are made on each leech, one at each reef-band; *reef-tackle cringles* at 3 feet below; and three *bowl-line-cringles*, the upper at 3 feet above the centre of the leech, and the other two equally divided between it and the clue.

Holes are made on the foot, one at the middle of each buntline-cloth.

* Rule for finding the gore at the top of *buntline cloths* inclined inwards:—Divide the number of cloths the buntline-cloth is gored inwards by $1\frac{1}{2}$ times the depth in yards, and the quotient will give the gore at the head in terms of a cloth. Thus—Suppose the buntline-cloth is gored one cloth and a half in the middle of the sail, and the perpendicular depth of it is 3 yds. 1 ft., then $3\frac{1}{2}$ yds. $\times 1\frac{1}{2} = \frac{10}{3} \times \frac{3}{2} = 5$, and $1\frac{1}{2}$ cloth = 3 ft. = 36 in. Therefore 5)36

—7 inches gore for the head of the buntline cloths.

The *clues* are cased with two-fold canvass or service leather, 18 inches each way from the clue over the spun yarn. The *clue cringles* are described at page 47.

In sowing on the bolt-rope, three inches of *slack cloth* are taken up in every yard in the leeches, and one inch in every cloth in the foot. (See note, page 21.)

*. * The foot-rope ought to be well stretched before it is roped.

TO DETERMINE THE SIZE OF A SQUARE MAINSAIL FOR A BRIG ?

The bunt of brigs' courses generally stands high, and the position of the tack is such as to clear the top part of the rail. Some vessels have the tack to *board* through a kind of stout thimble fitted in the top part of the rail, or through an eye-bolt, about one foot below the rail, as described in the foot-note, page 8. The dimensions of the following is to stand, in the bunt, 7 feet above the deck ; the rail is 3 feet high, and eye-bolt for the tack 2 feet above the deck. The measurements are as follows, thus :—

	FT.	IN.
<i>Depth</i> .—From the jackstay on the mainyard to deck	30	0
Bunt to stand above the deck	7	0
	23	0
Add for tablings	0	9
Middle cut	23	9
Foot-gore	3	3
Leech, cut	27	0
Main-yard, from cleat to cleat on the yard-arms	35	6
Subtract	4	0
Head	31	6
or 17 cloths, per table, page 18.		
<i>Half-foot</i> .—From 2 feet distant from the main-mast to the chess-tree, or eye-bolt	21	0
Deduct the allowance for the drift of the tack	1	6
The half-spread of the foot	19	6

DIMENSIONS FOR CUTTING-OUT.

Head	-	31	6 equal to 17 cloths.	Foot-gores—	
Foot	-	39	0 equal to 21 cloths.	1	
Leech	-	27	0 cut.	2	
Gore	-	3	3	3	
Middle	-	23	9 cut—5 squares.	4	
				5	Leech-
				7	gores.
				—	FT. IN.
				9	13 6
				11	13 6
				FT. IN.	— —
				3	6 = 42 27 0

MEMORANDUM.—This sail has one *reef-band*, at 5 feet down from the head, of one-quarter to one-third of a cloth. The *reef-tackle cringle* is 3 feet below the reef: often none.

Linings on the leeches are of one breadth of cloth, extending from the clue to the earing; and on the *foot*, one-third to one-half of a breadth from underneath the leech-linings.

Two *buntline-cloths*, at equal distances, or the foot divided into three parts, are carried up two yards, inclining at an angle inwards.

Three *bowlines*, the upper one at 3 feet above half-way of the leech, and the other two equally divided between it and the clue.

Holes are made on the foot, in the middle of each buntline-cloth.

The *thickness of bolt-rope* on the leeches and along the foot is $3\frac{1}{2}$ inches, and for 18 inches up each leech and along the foot to each buntline-hole is parcelled and served; and between the bunts it is sewed on the foot; but, frequently, the foot is roped throughout.

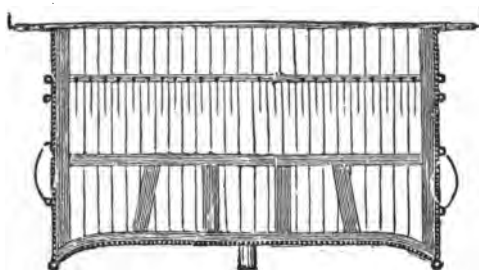
The *clues* are mostly fitted for chain-tacks. Cringles are stuck on the leeches, at the end of the reef-band and bowlines.

REEFING COURSES TO JACK-STAYS.

In the royal navy, and also in the merchant service, the upper reef of the main and fore-courses is generally reefed with half-legged points (on the fore side of the sail), which are flat-plaited, and made with eyes. Through those eyes, a small-sized rope is reeved; and this is called the *jack-line*. The points are thrust through every eyelet-hole from the after side; and, between every four eyelet-holes, the rope must be well stitched to the

sail ; the ends of the jack-line being spliced into the reef-criegles. If on each yard-arm, three points be left out, a *grab-rope*, or *reef-line*, may be formed, thus : — Take a piece of small rope, and splice one end to the eyelet-hole in the head of the sail, then reeve it through that left in the reef, and splice the other end into the same eyelet-hole in the head, leaving about two feet slack. This will be found of much use in gathering the sail up for reefing.

FORE-COURSE.



This sail is made of canvass No. 1 or 2. It is bent, at the head, to the jack-stay on the fore-yard, which hangs at right angles to the mast, and parallel to the deck. It hauls out at the earings within 18 inches of the hounds on the yard-arms, and drops to clear the mainstay, when carried to the stem, or 4 feet from the fore-castle deck, in ships which have a fore-castle.

Gores—(see page 7).—A gore is made on the *foot*, to drop the clue, usually 2 feet 6 inches to 4 feet, beginning at the three-fifths of the foot (in large courses). The depth of the *leech* (in a new ship with a fore-castle) is found thus :—

	FT.	IN.	FT.	IN.		FT.	IN.
Foremast, 74	0	-	12	3	head.	Fore-yard	- - 71 0
			4	6	sling.	" two arms	- 7 0
			19	9	housing.		
			6	6	F.C. deck.*	" hounded	- 64 0
						" within clts.	3 0
	43	0					
	31	0				Head	- - - 61 0
Stretching	1	0				or 33 cloths	(page 19).
Leech	-	30	0				

* When the vessel has not a fore-castle, take the height of the cat-head.

DIMENSIONS FOR CUTTING-OUT.

Head	-	-	61	0	equal to 33 cloths.
Leech	-	-	30	0	
Gore	-	-	4	0	
Middle	-	-	26	6	cut—17 squares.

Foot-gores, 2, 3, 5, 6, 7, 8, 10, 12 = 4ft. 5in.

Instructions for seams, tablings, holes, &c., are given in the last chapter. Two *reef-bands*, of one-third the breadth of a cloth, are put on large ships' courses, at the distance of 6 feet and 6 feet 6 inches asunder, the upper one being 6 feet from the head; the ends go to the rope under the leech linings, which are tabled twice over them. Ships of small tonnage have only one reef-band, 5 feet or 5 feet 6 inches below the head.

A *middle band*, of one breadth of canvass, is put on half-way between the reef-band and the foot, of No. 5 canvass. It is put on in the same way as that of the main-course. In smaller vessels there is half a breadth of canvass, extending from leech to leech under the linings, but often none at all.

Linings on the leeches are of one breadth of cloth, extending from the clue to the earing; and on the *foot* half a breadth from clue to clue. In coasters, foot bands are seldom used; and, when any, are one-third of a cloth.

Four *buntline-cloths*, at equal distances—or, the foot divided into five parts—are carried up to the lower side of the middle band; the outer bands are put on one and a half cloths, goring inwards, and the middle two straight up and down (see sketch page 58). The middle band is tabled upon the ends of the buntline-cloths, and the buntline-cloths are tabled over the foot-band. Two buntline-cloths only are put on small courses, run about 1 yard or $1\frac{1}{2}$ yards up from the foot.

Reef-cringles are made on the leeches, one at the end of each reef-band, stuck through holes close to the rope, or leaving room to take half a stitch; *reef tackle cringle* 3 feet below the reef; as also are two *bowline-cringles*, the upper bowline-crinkle being made in the middle of the leech, and the lower one equally distant from the upper one and the clue: a *hole* is also made at the end of each buntline-cloth on the foot, in the middle.

Cringles are also made in lieu of turned clues (see page 47), and a large *hole* worked-in close down to the cringle, for the clue-garnet block strop. The *clues* are *cased* with two-fold canvass or service leather half a yard each way over the spunyarn.

In sewing on the bolt-rope, three or four inches of *slack cloth*

should be taken up in every yard in the leeches, and one inch up in every cloth in the foot. The foot-rope ought to be well stretched before it is roped. (See page 21.)

BOOM-FORESAIL.

<i>Measurements.</i>		FT.	IN.
Foreyard, from cleat to cleat on the yard-arms	-	35	6
Subtract	- - -	3	0
		<hr/>	
		32	6

or $17\frac{1}{2}$ cloths (see page 18).

Depth.—The height of the centre of the yard from the mainstay, 17 feet.

	FT.	IN.
Boom, between the two auger-holes	- - - -	29 6

or $15\frac{3}{4}$ cloths (page 18).

Dimensions for Cutting-out.

	FT.	IN.	
Head	- - - - -	32 6	equal to $17\frac{1}{2}$ cloths.
Foot	- - - - -	29 6	equal to $15\frac{3}{4}$ cloths.
Depth	- - - - -	17 0	cut square on the foot.

MEMORANDUM.—*Linings* on the leeches are of one breadth and extend from the clue to the earing.

One-quarter to one-third of a breadth *foot-band*. A *reef-band*, one-fourth to one-third of a breadth, is put on at 5 feet below the head.

Two *buntline-cloths* run about one yard up from the foot; and small *cringles* are stuck in the bolt-rope, in lieu of buntline-holes.

Two *bowlines*, the upper bowline-crinkle being made in the middle of the leech, and the lower one equally distant from the upper one and the clue.

Cringles are made in the two lower corners or clues.

Bolt-rope.—The bolt-rope is sewed round the sail.

CROSS JACKSAIL.

This sail is made of canvass No. 3. The head is bent to the jack-stay on the cross jack-yard, and it drops at right-angles with the ship's mizenmast, and parallel to the deck, extending within 12 inches of the hounds on the yard-arms. The depth of this sail at the middle is made to clear 6 or 7 feet of the deck, so that it is cut with a deal of roach on the foot.

Gores.—Two *goring cloths* are on each *leech*; and the gore on the *foot* is 6 feet, beginning at the buntline-cloth, and increasing to give the drop at the clues. The gores are found in a similar way to those of the main-course.

For *seams, tablings, &c.*, consult the last chapter.

This sail has one *reef-band*, of one-third the breadth of a cloth, at 5 feet 6 inches down from the head. The ends go four inches under the leech-linings, which are tabled twice over them. A reef in this sail is not of any use: it is merely for the sake of uniformity with the other courses that it is put on. Like a small main-course, it has no *middle-band*.

Linings are of one breadth of cloth from the clue to the earing on the *leeches*, and half of a breadth of cloth from clue to clue on the *foot*.

Two *buntline cloths* are placed at equal distances between the leeches, or the foot is divided into three parts, extending from the foot to one-fourth up the sail.

A *reef-kringle* is made on each leech, one at each end of the reef-band, stuck through holes made in the tablings; two *bowline-kringles*, the upper one made in the middle of the leech, and the lower one equally distant from the upper one and the clue; a *buntline-hole* is also made at the end of each buntline-cloth on the foot, in the middle.

Kringles are also made in preference to turned clues; the clues are *cased* with canvass, as those of the main and fore courses, over the spunyarn; and a *hole* for the clue-garnet, which should be close to the kringle-holes.

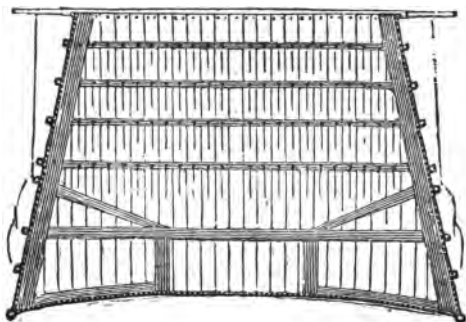
In sewing on the *bolt-rope*, a regular slack is taken up in the leeches and head, and one inch in every cloth in roping the foot throughout.

ON TOPSAILS.

These sails are quadrilateral, square on the head, and roached on the foot, and made of canvass No. 2 or No. 3. They are extended across the topmasts by the topsail-yards above, and by the lower-yards beneath, being fastened to the former by earings and robands (or good rope-yarns), and to the latter by means of the topsail-sheets, which, passing through iron cheek-blocks, brought on the after-side of the yard, well with the stops (as per sketch, page 47), and from thence through the quarter blocks, shackled on each side of the middle or slings of the yards, and led down by the mast. The topsail-yards are hoisted up by chain-*tyes* and rope-*haliards*. The upper-end of the

tye is first rove through the bullock-block from aft, then through the tye-block hooked into the eye of the hoop in the middle of the yard, and the end taken to the mast-head, where it is shackled to the chain-pendant on the side opposite the bullock-block ; the lower end of the tye comes down abaft the mast, to which a block is shackled, for any required purchase to be added, to hoist up the sail as far as the spider-hoop. (See page 6.)

MAIN-TOPSAIL.



To determine the Size?

RULE.

1. *The Hoist.*—The hounded length of the topmast, or mast-head, deducted from the extreme length of the topmast.

N.B.—Small vessels, from 250 to 300 tons, from the pinhole down to the heel.

2. *Head.*—Subtract the two yard-arms from the whole length of the topsail-yard, which gives the hounded length, and 4 feet for the earings within the cleats on the yard-arms.

3. *Close-reef.*—Subtract 5 feet from the whole length of the topsail-yard.

4. *Length of the Foot.*—Subtract the two yard-arms from the whole length of the lower-yard, and the result gives the hounded length, from which deduct 3 inches in every $3\frac{1}{2}$ feet of the hounded length, for the sheave-holes within the stops and the foot of the sail stretching, thus :—Suppose the whole length of a lower-yard 63 feet, and the arms 3ft. 6in. each. From 63 subtract 7, leaving 56 feet, the hounded length ; and 56 divided by $3\frac{1}{2}$ gives 16, which, multiplied by 3 inches, equals 48 inches or 4 feet,

the distance the foot is to be short of the hounded length :— thus, the length of the foot will be 52 feet.

The *Roach on the Foot* is about 2ft. 6in. for main and fore-topsails, and 3 feet for mizen-topsails.

In the royal navy, the feet of the topsails are cut *straight*, because the blocks attached to the clues lift the foot above the yards to clear the stays. (See sketch, page 46.)

EXAMPLE

	FT.	IN.		FT.	IN.
Topmast - - -	40	0	Lower-yard - -	63	0
Head -	5	6	Two Arms	7	0
<hr/>			<hr/>		
Hoist -	34	6	Hounded	56	0
Gore -	2	6	Subtract	4	0
<hr/>			<hr/>		
Middle	32	0 cut.	Foot - -	52	0
			or 29 cloths, per table		
			page 20.		
	FT.	IN.		FT.	IN.
Topsail-yard -	48	9	Topsail-yard -	48	9
Two Arms	7	0	Subtract -	5	0
<hr/>			<hr/>		
	41	9	Close-reef - -	43	9
Subtract	4	0	<hr/>		
<hr/>			<hr/>		
Head -	37	9			
or 20½ cloths, per table page 19.					

DIMENSIONS FOR CUTTING-OUT.

	FT.	IN.		Foot Gores.
				IN.
Head -	37	9 equal 20½ cloths.	1	
Reef -	43	9 equal 23½ cloths.	1	
Foot -	52	0 equal 29 cloths.	2	Leech-
Hoist -	34	6	2	gores.
Gore -	2	6	3	FT. IN.
Middle	32	0 cut—9 squares.	3	— 6 0
			4	— 11 0
			4	— 6 6
			5	— 6 0
			6	— 5 0
			<hr/>	

2ft. 7in. = 31 34 6

This sail is made of No. 2, and lined with No. 5 canvass. It has three or four *reef-bands*, put on at, or 18 inches above, the centre of the *close-reef*, when there are four reefs in the sail, and the upper reef is 4 feet distant from the head; the others are divided equally between it and the lower-reef, and they extend from leech to leech underneath the linings. They are each half of a breadth of canvass, put on double: the first side is stuck twice long-work, and the last turned over and tabled close-work, which gives strength to the eyelet-holes for the reef-points.

One or two *middle-bands* are put on between the lower reef-band and the foot, and are made and put on in the same way as that of the main-course.

Linings.—The *leeches* are lined from clue to earing with one breadth of cloth, and the *foot* is lined from the clue under the leech-lining to the buntline-hole with half a breadth. Two *buntline-cloths* are put on the foreside of the sail, at one-third the foot: their ends go under the foot-band, and are carried up under the middle-band, which is tabled twice on them.

The *reef-tackle cringle* is 3 feet below the lower-reef. The *reef-tackle pieces* are put on the foreside of the sail, and are so cut and sewed as, when put on, to be two-thirds broad at the leeches, and one-third at the end which reaches to the top of the buntline-cloth, and tabled twice, under the middle-band.

Also, a *top-lining* on the aft-side, which covers one-third of the cloths in the foot, and is carried up so as to sew the top-edge to the centre of the middle-band, and *two cloths* run up to the head, covering the centre-cloths of the sail.

In the royal navy the short-cloths of the top-lining run up to the middle-band, and the two mast-cloths run up as high as the *third* reef. The reef-tackle pieces are put on in the direction of the buntline-cloths—three yards long from the leech. The foot-band is half of a breadth, and extends from clue to clue.

Three *bowline-cringles*,* the upper one being $2\frac{1}{2}$ feet below the reef-tackle, and the other two equally distant from each other between the upper one and the clue. One *buntline-hole* is made in the middle of each buntline-cloth; and, also, a hole in the middle of the foot, for the spilling-line.

The *bolt-rope* along the foot is roped, and for 3 feet up each leech is parcelled and served; and before it is roped to the sail,

* Two are much better, when the reef-tackle cringle is used for the upper bowline.

the foot-rope should be well stretched, and the length of the foot of the sail set off.

Cringles are made on the leeches at the end of each reef-band, and in lieu of turned clues, which are described in the foregoing chapter.

Beckets for *bunt-jigger*.—Work *two holes* on each side of the centre-seam, in the first and second reefs; the first for furling with one reef, and the second with two.

Eyelet-holes for *reef-earings*.—Make an eyelet-hole below each cringle, for the standing part of the earings to splice into.

FORE-TOPSAIL.

This sail is made of No. 2 or No. 3, and lined with No. 5 or No. 6 canvass. It has the same number of *reefs* in it as the main-topsail; and the *linings*, &c., are exactly similar to those of the main-topsail.

MIZEN-TOPSAIL.

This sail is made of canvass No. 3, and lined with No. 5. It has *three reef-bands*,* put on similar to those of the main-topsail. A *middle-band* and *buntline-pieces* are only put on sometimes.

The *reef-tackle cringle* is 3 feet below the close-reef, and *two bowlines*,† the upper one 3 feet below the reef-tackle. The *reef-tackle pieces* are put on the aft-side of the sail, extending from the leech to the top-lining.

The *top-lining* is put on the aft-side, and covers one-third the foot, and is carried up half-way between the lower-reef and foot. Two *mast-cloths* are put on in the middle of the sail, on the aft-side, between the foot and head.

Linings on the *leeches* and *foot*, the same as the main-topsail.

Cringles are made on the leeches, stuck through holes worked at the end of each reef-band, reef-tackle piece, and bowlines; *cringles*, also, are stuck in lieu of turned clues. One *buntline hole* is made at the edge of the top-lining on each side, to take the foot-band.

The *bolt-rope* along the foot is roped, and for 18 inches to 2 feet up each leech is parcelled and served, then marled round the clue.

* They may be fitted with *four*, which, except for the sake of uniformity, is not of much use.

† Sometimes *three*.

TO DETERMINE THE SIZE OF A TOPSAIL FOR A BRIG OF
18 KEELS?*

The close-reef of the topsail, and the length of the foot, govern the length of the head of the sail; and it is to be observed, that the close-reef must never extend beyond the *lifts* of the topsail-yard. Hence, the method of fixing the length on the head of the topsail, or the distance of the head of the sail from the topsail lifts, will cause the hollow given to the leeches of the topsails always to be more or less, according as the lengths of the lower yards at the sheaves exceed the lengths of the topsail-yards at the lifts, or place of the low-reef, which, in colliers, is invariable, and gives the leeches a very considerable hollow. Thus:—Suppose a topsail has 18 cloths in the foot, 14 cloths in the close-reef, and the leeches require a hollow of half a cloth on each side, what number of cloths ought there to be in the head?

Here - - 14 cloths in the close-reef.
Add - - 1 cloth, the hollow of the two leeches.

15 cloths in the reef, when straight.
2 or twice.

30
Subtract - 18 cloths in the foot.

12 cloths in the head.

Again:—If we suppose 19 cloths in the foot, and the rest the same as before, it will be seen that the cloths in the head are less.

Thus - - 14 cloths in the reef.
Add - - 1 cloth, the hollow.

15 cloths in the reef, straight leeches.
2 or twice.

30
Subtract - 19 cloths in the foot

11 cloths in the head.

* *Keel* is a name given to a low, flat, interior vessel, used to bring coals down the river Tyne for loading the colliers. Hence, a collier is said to carry so many "keels" of coals.

Showing that the head is entirely regulated by the reef and foot: consequently, the cloths in the foot and close-reef must be determined first, and then see whether the leeches will require much or little hollow for the head to extend well out on the topsail-yard, which is generally from 2 to $2\frac{1}{2}$ feet on each side, from the topsail-lifts.

TOPSAIL.

Measurements.

	FT.	IN.	
Topsail-yard, from lift to lift	27	8	Topmast, from the pin
Subtract	1	6	of the sheave-hole
			down to the heel,
Reef	26	2	27ft. 9in.
or 14 cloths in the reef (page 18).			

	FT.	IN.
Mainyard, pin and pin	34	0
Subtract	1	6

or 18 cloths (page 20). 32 6 the foot.

Head.—To make the leeches straight in this sail, there must be only 10 cloths in the *head*, which will measure 18ft. 6in.; that is, bringing the earings 4ft. 7in. on each side from the hauling-out to the cleats, which is a great deal too much. Hence, we must hollow the leeches to get a squarer head—generally half a cloth on each side. The cloths in the head are shown in page 66.

Dimensions for Cutting-out.

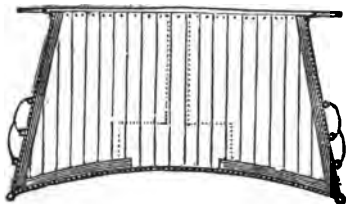
	FT.	IN.	Foot-gores.	
Head	22	4 equal to 12 cloths.	IN.	
Reef	26	2 equal to 14 cloths.	1	
Foot	32	6 equal to 18 cloths.	2	
Hoist	27	9	3	Leech-
Gore	2	6	4	gores.
Middle	25	3 cut—4 squares.	—	FT. IN.
			5	14 0
			7	7 9
			9	6 0
			31	27 9

The construction of the plan for cutting hollow-leeches is given at page 32. But leech-gores (like the above) are easily

calculated, for it is only to cut the first leech-cloth a little deeper than half-way down the hoist, and regulate the remaining cloths so as to make about 18 or 20 inches difference of them, according to the number of cloths in the leech. Say :— If four cloths, lessen the difference, take care that the whole of the gores do not exceed the hoist or length of the leech. The calculations, however, are only approximate, and founded on a good natural judgment and long practice. It is always the better plan, before cutting the leeches out, to make a draught of the gored side of the sail.

ON TOPGALLANT SAILS.

These sails are quadrilateral, square on the head, and roached on the foot, and made of canvass No. 4 or No. 5. They are extended above the topsail-yards, in the same manner as the topsails are extended above the lower-yards. The quantity of roach given to the foot of topgallant-sails, for large ships, is four feet, and for small ships about three feet. The roach here given is for clearing the topmast-stays, when



the topsails are reefed. To lessen the roach in the topgallant-sails would be somewhat advantageous with whole topsails set; but when the topsails are reefed, the topgallant-sheets must be started, instead of being sheeted home, as they ought always to be. The mizen-topgallant-sail is commonly roached as much as 5ft. 6in., on account of the standing part of the main-topgallant braces leading to the mizen-topmast stay; and, particularly so, to allow the sheets to come home over the single-reefed mizen-topsail.

MAIN-TOPGALLANT-SAIL.

To determine the Size

RULE.

1. The *Hoist*.—The hounded length of the topgallant-mast, with one foot added.
2. The *Head*.—Subtracting the two yard-arms from the whole length of the yard, gives the hounded length, and two to three feet for the earings to come within the cleats on the yard-arms.
3. The *Foot*.—Subtracting the two yard-arms from the whole

length of the topsail-yard, gives the hounded length ; and 18 inches for the sheets to come within the hounds, gives the length of the foot for sheeting home :—Thus, suppose the whole length of a topsail-yard 45 feet, and the arms 3 feet each. From 45 subtract 6, leaving 39 feet, the hounded length ; and 1ft. 6in. taken from the hounded length gives 37ft. 6in.; the length of the foot.

EXAMPLE.

	FT.	IN.		FT.	IN.
Topgallant-mast -	18	6	Top-sail-yard -	45	0
Add -	1	0	Two Arms	6	0
<hr/>			<hr/>		
Hoist -	19	6	Hounded	39	0
Gore -	3	6	Subtract	1	6
<hr/>			<hr/>		
Middle -	16	0 cut.	Foot -	37	6
or 20 $\frac{1}{4}$ cloths, per table page 21.					

	FT.	IN.
Topgallant-yard -	33	0
Two Arms -	4	0
<hr/>		29 0
Subtract -	2	0
<hr/>		Head - 27 0
or 14 $\frac{1}{4}$ cloths, per table page 18		

DIMENSIONS FOR CUTTING-OUT.

	FT.	IN.	Foot-gores.
Head -	27	0 equal to 14 $\frac{1}{4}$ cloths.	IN.
Foot -	37	6 equal to 20 $\frac{1}{4}$ cloths.	1
Hoist -	19	6	2
Gore -	3	6	3
Middle -	16	0 cut—2 squares.	4
			5
			6
			7
			8
			9
			2
			— 5 7
			— 6 5
			— 6 5
			— 1 7
			<hr/>
			47
			20
			0

This sail is made of No. 4 or No. 5 canvass, and lined with No. 6.

Three bowline cringles are made on each leech, the upper one in the middle, and the others equally divided between that and the clue.

Linings on the *leeches* are of half a breadth of canvass, extending from the clue to the earing; and the *foot-band* of the same breadth extends from the clue (underneath the leech-lining), to one-third the length of the sail at the foot. Also, a *top-lining* on the aft-side of the sail, which covers one-third of the cloths in the foot, and runs up one-third the depth of the middle. One *buntline-hole* is made at the one-third of the foot, on each side of the top-lining, for receiving the foot-band end.

One *mast-cloth* is put on the middle of the sail, on the aft-side, between the top-lining and head.

Cringles are made in lieu of turned clues, and a *hole* for the clue-garnet.

The foot is roped and the clue marled, about 18 inches each way.

FORE-TOPGALLANT-SAIL.

This sail is made of No. 4 or No. 5, and lined with No. 6 canvass: it has the same number of bowlines in it as the main-topgallant-sail.

The *linings*, &c., are exactly similar to those of the main-topgallant-sail. It may, however, be observed, that it is *best* to make the sail with an odd number of squares, so that the *mast-cloth*, on the aft side, shall cover the centre-cloth in the sail, which answers better for wear.

MIZEN-TOPGALLANT-SAIL.

This sail is made of No. 5, and lined with No. 6 canvass.

Two *bowline-cringles* are made on each leech, the upper one in the middle, the other half-way between it and the clue.

The *linings* are the same as for the main-topgallant-sail. Also, a *top-lining* on the aft-side of the sail, which covers one-third the cloths in the foot, the short-cloths running up one yard, and the centre cloth from the foot to the head.

The *foot* is roped similar to the fore and main-topgallant-sails. *Cringles* are stuck for the sheets, and a *hole* for the clue-garnet.

In the royal navy the topgallant-sails are made of No. 5, and have *no* linings on them, except one-foot corner-pieces.

N.B.—Service-leather ought to be sewed on the clues of sails,

where they rub against the yard ; also, from buntline-hole to buntline-hole where the foot rubs against the stay and braces, particularly the *mizen-topgallant-sail*.

ON ROYALS.

The royals spread immediately above the topgallant-sails, to whose yards the lower corners of them are attached : they are sometimes termed topgallant-royals, and are never used but in fine weather.



MAIN-ROYAL.

To determine the Size ?

RULE.

The *Hoist*.—The hounded length of the royal-mast.

The *Head*.—Subtract the two yard-arms from the whole length of the yard, which gives the hounded length, and one to two feet for the earings to come within the cleats on the yard-arms, which gives the *length on the head*.

The *Foot*.—Subtracting the two yard-arms from the length of the topgallant-yard, and 18 inches subtracted from the hounded length gives the *length of the foot* sheeted home.

The *Roach on the Foot* is about 2 feet for main and fore-royals, and 2ft. 6in. for mizen-royals.

This sail is made of No. 6 canvass. Two *bowline cringles* are stuck in the leech-ropes, the upper one in the middle, and the other half-way between it and the clue.

Linings.—The *foot* is lined with one-third of a breadth of cloth from clue to clue : pieces are put on at the *earings*. Cringles are stuck for the sheets. No buntline-holes are made in the foot ; and the foot is roped in the same way as that of the mizen-topgallant-sail.

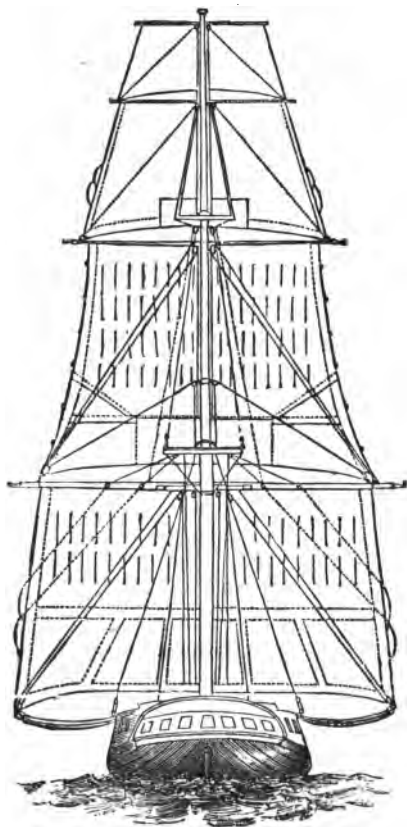
FORE-ROYAL.

This sail is made of No. 6 canvass : it is finished in precisely the same way as the main-royal.

MIZEN-ROYAL.

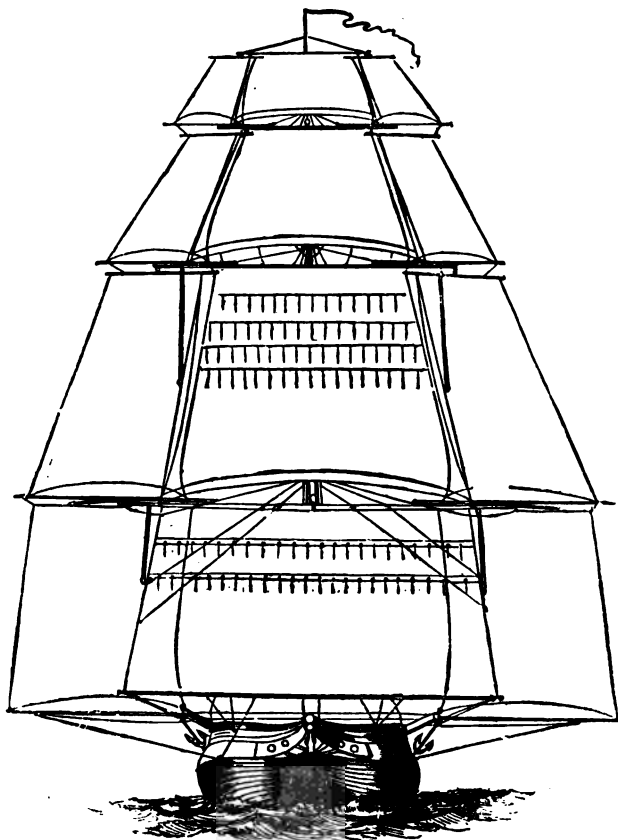
This sail is made of No. 6 canvass. *Pieces* are put on at all the corners, and the clues only are served and marled in, having *oringles* stuck for the sheets.

The following sketch exhibits the sails already treated upon expanded in their proper places :—it also shows the leading of the various ropes attached to the sails, as buntlines, clue-garnets, bowline - bridles, leech - lines, slab - lines, reef - points, cringles, &c. ; as also the shrouds, lifts, &c.



STERN VIEW OF THE SAILS ON MAIN-MAST.

The sketch on this page represents the *studding-sails* spread out beyond the leeches of the principal sails, attached to the foremast, where they appear as wings to the yard-arms ; as also the gear attached to the sails, &c. A description of making studding-sails is given in the following pages.

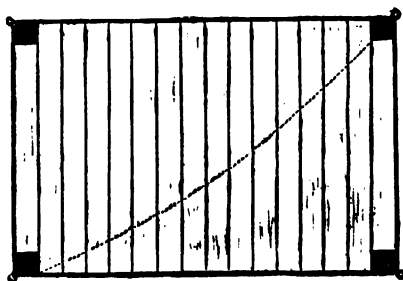


HEAD VIEW OF THE SAILS ON FORE-MAST

ON STUDDING-SAILS.

LOWER STUDDING-SAILS.

These sails are quadrilateral, square on the head, foot, and leeches, and made of No. 4 or No. 5 canvass. They are extended, in moderate and steady breezes, beyond the leeches of the forecourse, as shown by the sketch on page 73, the heads being bent to the fore studding-sail yards, at the one-third or one-half of the cloths from the outer leech, and the feet extended on the



booms, and, sometimes, further extended by jack-yards. The boom, which extends the foot of the lower studding-sail, is hooked or fitted to the foremost part of the fore-channels by means of a goose-neck, or else swings off with the sail to which it is suspended, being kept steady by ropes termed "guys."

Recently, *three cornered* or *triangular* lower studding-sails have been adopted, for dispensing with swinging-booms. The dotted line on the above sketch represents the outer-leech, which it will be seen is *curved* to prevent it from blowing into a hollow. This plan of making lower studding-sails not only saves the cost of the booms, but also the gear for supporting the booms—as fore and after guys, topping-lifts, out-haulers, martingales, blocks, &c.—besides canvass. Some captains, however, do not approve of the plan, because less canvass is spread than by the square lower studding-sail. The plan seems better adapted for schooners, which have very square cross jack-yards, than it is for large vessels.

The rule for determining the size of lower studding-sails is given at page 11.

Pieces, three-quarters of a yard in length, are put on the four corners, and a *piece* half a yard long, on the third or the middle of the head.

Holes are made on that part of the head which is bent to the yard; and two in each clue, and centre or third of the cloths in the head, for the cringles.

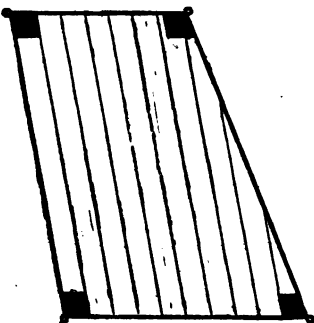
In sewing on the bolt-rope, *slack* canvass should be taken up

round the sail ; but the bolt-rope on the outer-leech of three-cornered lower studding-sails must be sewed-on like the foot-rope on a mainsail.

Cringles, with galvanized thimbles, are stuck in the clue and tack ; the earings being served, as well as the cringle, in the head.

MAIN AND FORE-TOPMAST STUDDING-SAILS.

These sails are quadrilateral, gored on the head, foot, and outer leech, and made of No. 4 or No. 5 canvass. They are set on the outside of the topsails, as shown on the sketch (page 73), the heads being bent to their respective yards, and the feet extended by booms, which slide out on the extremities of the lower yards. The inner-earring covers two cloths, and the clue one cloth of the top-sail-leech. To find the size, refer to rule on page 11.



A regular *gore* is made on the head and foot, decreasing to the outer-earring, and increasing in depth from the inner-leech. The gore is given on account of the studding-sail inclining at an angle inwards, or by its spreading beyond the leeches of the topsail. Hence, the gore on the head and foot is governed by the number of goring-cloths in the leeches of the topsail ; and the greater the number of goring-cloths in the topsail-leech, the stronger the head and foot-gores must be of the studding-sail ; and the less cloths in the topsail-leeches, the lesser gores on the head and foot of the studding-sail ; and were there no goring-cloths in the leeches (like a foresail), the head and foot would then have to be cut square.

To find the gore on the head and foot of topmast and topgallant studding-sails ?

RULE.

Divide the number of cloths in the leech of the topsail by one-and-a-half times the depth in yards of the leech of the topmast studding-sail, and the quotient will give the gore at the head in terms of a cloth. Thus :—Suppose the number of cloths in the leech of the topsail is *four*, and the length of the leech of the studding-sail, or hoist of the topsail, 10 yards

Then, 10 yards \times $1\frac{1}{2}$ times = 15, and 4 cloths = 8 feet = 96 inches. Therefore, 96 divided by 15 gives 6 inches gore for the head of the studding-sail.

A *reef-band* is sometimes put on at five feet down from the head, and *pieces* on the four corners. Two holes are made at the clue for the cringle; and two holes for the down-hauls on the outer-leech, at one-third the depth of the leech from the head, the upper-hole, and the other hole halfway between the upper-hole and the tack.

The *head-holes* are cut one and two in each cloth respectively.

In sewing on the bolt-rope, *slack* canvass should be taken in the foot and goring-leech, but none in the square-leech. The *tack* is served and marled about 18 inches each way.

The *earings* are served, and galvanized thimbles are put in the clue-cringle and tack.

MAIN AND FORE-TOPGALLANT STUDDING-SAILS.

These sails are quadrilateral, gored on the head, foot, and outer-leech, and made of No. 6 canvass, and spread beyond the leeches of the topgallant-sails, as shown on the sketch (page 73).



They are extended at the foot by booms, which slide out at the extremities of the topsail-yards, and their heads or upper edges are attached to small yards, which are hoisted up to the topgallant yard-arms. The inner-earings cover one-and-a-half cloths, and the clues three-quarters of a cloth of the leeches of the topgallant-sail. To find the size, refer to rule at page 12, and head and foot gores at page 75. They are finished in a similar way as the topmast studding-sails.

ROYAL STUDDING-SAILS.

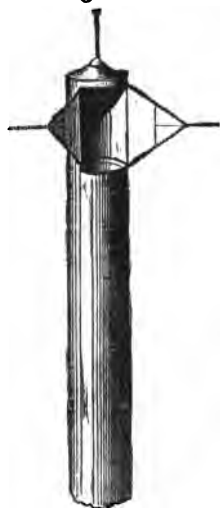
These sails are made of No. 7 canvass, and spread beyond the leeches of the royals. They are finished in the same way as the preceding. To obtain the size, refer to rules at page 12, which are applicable to studding-sails.

Some ships have *mizen-topmast studding-sails*, but they are rarely used.

Under frigates of the second class to frigates of the sixth class inclusive, the lower and top studding-sails are made of No. 6 canvass, and topgallant studding-sails of No. 7 or No. 8 canvass.

WINDSAILS.

The windsail or ventilator, is made of canvass No. 5. It is employed to convey a stream of fresh air downwards into the lower apartments of a ship, being let down through the hatches, and is in the form of a wide tube or funnel. It is kept distended by *circular hoops*, made of ash, and sewed to the inside—one at the top, and others at distances of six feet. The upper part or top is covered with a circular piece of canvass, and below the top is an opening on one side, to which *wings* are sewed, of two breadths of canvass each, tapering to a point, which are braced to the wind so as to receive the full current of air, which fills the tube, and rushes downwards into the lower regions of the ship. Large merchantmen have generally, in hot climates, three or four of these windsails, for the preservation of the health of the crew.



These windsails are about 8 yards in length; and four breadths are sewed together with a half-inch seam. In joining them, one cloth is left, or cut five or six feet short at the top. A three-inch tabling goes round the top and bottom; and, at every six feet distance, a six-inch band is tabled for the hoops, which are sewed to the inside. The *wings* are cut thus:—One breadth of cloth, 6 feet 6 inches long, has a gore of 20 inches cut off at each end, then laced together, and sewed to it, thus making two breadths tapered to a point. A small rope is sewed all round the edge of the wings and opening of the tube, and an eye or clue formed at the points of the wings. At the top a diamond piece is stitched on, for working in a grommet for a becket, which is spliced with a stopper-knot, for the windsail to hang by. Two or three holes are worked in the edge of the tabling, at the bottom, to keep it steady.

AWNINGS.

These are made of canvass No. 3 or 4. They are spread flat over the ship, above the deck, for protection from the rays of the sun in hot climates, and are sewed together athwartship with an inch seam, and tabled at the ends with a three-inch tabling.

then *lined* with half a breadth of canvass. A whole breadth is sewed along the *ridge* of each awning. Valances are attached to the side, of one-third of a breadth of canvass, which are sometimes scalloped, and bound with baize of some fancy colour. The diameter of the masts is cut out in the middle at each end, and lacing holes are made across the ends, one foot distant, to connect one awning with the other.

On the upper part, along the middle of the ridge-lining, two small holes are made in every seam, about one inch apart, and two at each end, to which the ridge-rope is seized on, in lieu of being roped on. Round the margins of each awning and mast-holes is sewed one-and-a-half or two-inch rope. *Cringles* are stuck at the end of each seam, and small earings with galvanized thimbles in the four corners.

In the royal navy the awnings are made of No. 4 canvass, and along the ridge is sewed only one-half of a breadth-lining; the ridge-rope is incased in the canvass, or sewed on the centre of the ridge, like the side rope. The valances are about one foot deep.

Sometimes *curtains* are made to hang to the sides of the awnings of the same length as the awnings (see page 12). Their depth is usually two yards, and are sewed together with an inch seam, as those of the awning, and tabled all round with a two or three-inch tabling, containing spunyarn in the inside for giving additional strength to the *lacing-holes*, which are made one yard apart along the upper tabling of the curtain. A hole is made in each of the lower corners to steady it.

HAMMOCK-CLOTHS.

In the royal navy, as also large merchant ships, on the rough-tree-rails all round the ship are placed boxes, technically called *hammock-nettings*, for the reception of the sailors' hammocks or beds, which are stowed in them during the day. The hammocks, when stowed in the nettings, are protected from the rain and the sea by *hammock-cloths* of painted canvass, which are made thus:—Double berthing, 2½ cloths, and single 2 cloths. The inside edge has a band stitched on the inside; the band is cut 6 inches wide, and doubled to 3 inches (similar to a double reef-band). The lower edge or double part is kept one inch above the edge of the hammock-cloth, and along the lower edge of the band are holes 18 inches apart, worked like button-holes, for slipping over staples or eyes, to toggle the inside of the cloths, and when all is made fast the toggles are covered.

CHAPTER IV

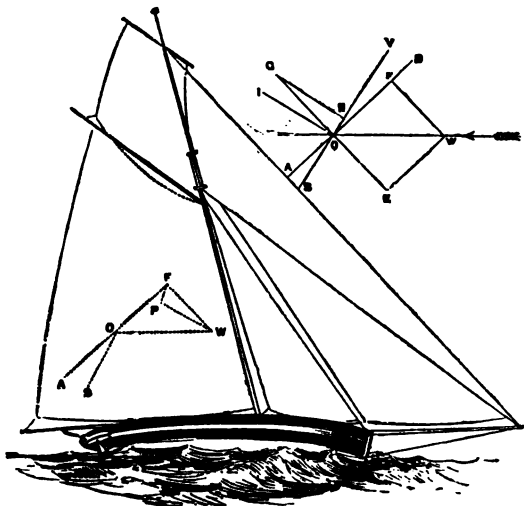
ON FORE-AND-AFT SAILS.

On Flat Sails in general.—How the Wind strikes the Sail, in turning to windward.—The Way to make Flat Fore-and-Aft Sails.—Jibs :—Flying Jib—Standing Jib—Angulated Jibs.—Spanker.—Trysails.—Gaff-Top-sails. — Staysails :—Fore-Topmast-Staysails — Fore-Staysails — Main-Staysail — A Collier's Main-Staysail — Main-Topmast-Staysail — Main-Toppallant-Staysail—Royal-Staysail—Mizen-Staysail—Mizen-Topmast-Staysail—Mizen-Toppallant-Staysail, &c.

ON FLAT-SAILS IN GENERAL.

There cannot be a question but that the sailing qualities of a vessel materially depend upon *flat sails*, and particularly on fore-and-aft-sails that will trim close to the wind. It would be a waste of words to dwell on the many advantages resulting from vessels having flat sails, the signal victory of the far-famed American yacht over the Royal Yacht Squadron having for ever settled their superiority. Not but that, years before, the advantage which would be gained by flat sails was known to nautical men ; but sailmakers were ignorant of the principles on which sails to stand flat must be constructed ; and, even at the present day, several cut their sails to bag in the middle, although it is known that such bagging gives the wind a less power, especially when sailing close-hauled, for the parts so bagging-out being scarcely struck at all by the wind, are filled only with eddies from the adjoining parts of the sail, which eddies have no force at all. Moreover, the flat sail catches more wind than the concave one, even though the concave one be larger ; for the wind strikes perpendicularly upon all the parts of the former, but to the latter only a pressure in proportion to the angles of incidence is given. Hence, it is evident that if the wind does not fall perpendicularly upon the sail, but strikes it obliquely, the wind will hardly have any effect on the windward part of the concave or bellying sail, and its impulse upon the leeward part, to which it is more perpendicular, causes it to flat-off the vessel, being, as it is, nearly parallel to the keel ; besides, it often happens that that part of the sail near the after-leech, when the sheet is hauled aft, proves entirely a back-sail, the bad effects of which are too well known to require an explanation.

Though it may not be in keeping with the nature of this work to enter upon the practice of seamanship, it may still not be uninteresting to show, by the following sketch, how the best effects may be produced by flat sails, in turning to windward, and impelling the vessel ahead; and, while there is nothing new in the investigation to those who have a knowledge of the principle known in mechanics as "the composition and resolution of forces," it may still be useful to the student to inform him how a wind, which is nearly opposed to the course of a vessel, may notwithstanding be made to impel her in the desired direction by the agency of sails.



Let AB or AF be the position of the sail, AOS the angle formed by the sail and the direction of the keel, of which, be it remembered, the boom is always on the lee-side. If the line WO be taken to express the direction of the wind and its force, let $OEFW$ be a rectangular parallelogram, of which WO is the diagonal. The force WO will be equivalent to two forces, one in the direction EO , perpendicular to the sail, and the other, OF , in the plane of the canvass. The effect, OF , is entirely ineffectual, excepting only as regards friction—it glides off the surface of the flat sail without otherwise producing

any detriment upon the vessel, and the other, EO , equals the effective force on the sail, estimated full against its face. Next resolve WF into WP and PF respectively, perpendicular and parallel to SO ; the part OI or WP produces leeway, and the part OH or PF (drawn on the sail) *impels forward*. The form of the vessel is evidently such as to offer a great resistance to the former force, and very little to the latter. The vessel, therefore, proceeds with considerable velocity in the direction SV of its keel, and makes way slowly in the sideward direction OI , or to leeward.

Having thus briefly noticed the effects produced by flatness of sails to facilitate speed, it is requisite to proceed to set forth the principles on which sails are made to stand flat. The first thing to be done towards making fore-and-aft quadrilateral sails set flat, is to be particular in taking the lengths, as directed in page 10, and give proper allowances for the sail stretching. It is evident, from practical experience, that from want of proper allowances being given to the foot, the clue of the sail hauls out to the boom-end at first setting; and it is likewise evident, that not the least calculation is made for the *foot-gore*, as to the rake of the mast, whether it has much rake or little. The greater the rake of the mast, the less the foot-gore. How frequently do we hear of mainsails not standing, or that the after-leech hangs slack, with a variety of complaints, proceeding from inattention to the rake of the masts and the rise aft of the booms with the sheer of the deck, showing the necessity of always taking the length of the *cross-gore*, and making a plan of the sail, to get the foot-gore.

The following rules and observations may be depended upon as being correct for merchant-vessels' sails, as they are the results of upwards of twenty years' constant practice.

FORE-AND-AFT MAINSAILS, SPANKERS, ETC.

RULES.

Referring to page 10 :—

1. The *head*.—The head is within the stops, 1ft. 6in. or 2ft.
2. The *foot*.—The length of the foot is to be short of the length of the boom 4 inches in every 3 feet, for the foot and diagonal stretching of the sail.

Note.—When bending a new fore-and-aft sail, it is a common practice with seamen to stretch it as much as ever it will bear, particularly on the foot, which is decidedly wrong. It ought to be drawn out gradually, as the force of the wind stretches it best.

3. The *fore-leech*.—When the gaff and sail are hoisted to the proper height, the tack ought to be above the boom about 15 or 18 inches. Some fancy the tack should reach within a foot of the boom.

4. The *after-leech*.—The quantity of peak in a fore-and-aft mainsail is entirely according to taste. When with a narrow head and much peak, the sail has a handsome appearance; but a wide head and little peak is better adapted to quick sailing. In the merchant-service, the proportion of the length of the after-leech to the luff, which determines the peak, is generally one and three-fifths the luff; and in brigs, about one-half longer than the depth of the fore-leech.

5. The amount of the *foot-gores*, which determines the position of the clue, must be taken from a drawing similar to the sketch on page 10, then make an allowance for the eating-in of seaming, as expressed at page 36.

6. The amount of the *head-gores*, for giving the sail peak, is taken in like manner from the drawing; but the slack which is put in the leech is to be subtracted from it, as the slack, depth of the luff, foot and head gores, added together, and deducted from their sum, the eating-in of seaming of the luff and foot-gores, equals the length of the after-leech. (See page 37.)

7. The *slack*, for giving a round and flowing after-leech, is by means of gathering slack canvass in the seaming-up of the cloth in the after-leech, or *puckering* the seams, in a gradual manner. The slack, however, should be held on all above the reefs, that is, 1 inch in every 3 feet down from the head to the upper-reef in the leech seam, and 1 inch less in the next seam, and so on, 1 inch less in every seam from the leech; but when the sail has a narrow head and a long leech, the slack is more quickly diminished. The seams thus sewed, and the slack allowed in the cutting-out, form the curve on the leech, which, rightly managed, will be an extremely near approximation to a circular arc. The same means give the utmost freedom to the after-leech: the wind glides off unchecked or unobstructed, and thereby the belly which was made by the broad seams is taken out, and the sail brought back as near as possible to a perfect plane; besides, the straining of the leech into a hollow is completely avoided—at least, as far as it is practicable. (See page 15.)

8. The *depth of the luff* of a mainsail or a spanker is determined thus:—Add the length of the mast-head, the distance

the gaff works below the hounds, the housing of the mast, and the height of the boom—the sum of which, subtracted from the whole length of the mast, and 16 or 18 inches from the remainder, gives the *depth of the fore-leech or luff*. Take for an example a

SPANKER.

	FT.	IN.	FT.	IN.	
Mizenmast	68	0	8	0	Head.
			5	0	Cheeks, or gaff below the hounds.
			18	5	Housing.
			6	6	Height of round-house.*
			2	7	Height of the boom.
			1	6	Stretching.

42 0

Depth of luff- 26 0

	FT.	IN.		FT.	IN.
Gaff	31	0	Boom	39	0
Pole	4	6	Subtract	4	6
Hounded-	26	6		34	6
Subtract-	1	6	Sheet block	1	0
Head-	25	0	Foot of sail-	33	6

* When the vessel has a round-house, the boom is kept as low as it can be conveniently worked over the skylight on the house.

9. *The luff* of a jib-headed gaff-topsail is found thus:—Add the distance the gaff is below the hounds of the mast, to the sum of the lengths of the topmast and topgallant-mast or pole, and 18 inches from the amount, gives the hoist of a gaff-topsail.

EXAMPLE.

	FT.	IN.	
Mizen-topmast	33	0	The quantity of cloths in the head of the mizen equals the quantity of cloths in the foot of the gaff-topsail.
Topgallant-mast	12	9	
Gaff below the heel of topmast	5	0	
	50	9	
Subtract	1	9	
Hoist on luff	49	0	

Having made a plan of the above, and taken therefrom the lengths of the after-leech and foot-gore, proceed to make out

the dimensions for cutting the sail to the size determined on by the rules here given. The dimensions for cutting this gaff-topsail are given at page 37.

DIMENSIONS FOR CUTTING-OUT A SPANKER.

		FT. IN.							
Head-	- -	25	0	equal to 13 cloths.					
Foot -	- -	33	6	equal to 18 cloths.					
Leech -	- -	44	0	tabled.					
Mast-	- -	26	0	tabled.					
Head-gore	- 11	9	Round of leech, 2ft. 3in.						
Foot-gore	- 8	9	Round of foot, 2ft. 8in.						
Cloths.	Foot-gores.	Mast-gores.		Width of Seams at the foot.		Length of taper.			
	IN.	FT.	IN.	IN.		FT.	IN.		
1	... 15	5	6	3	...	2	0		
2	... 14	5	6	3	...	2	6		
3	... 13	5	2	2 $\frac{3}{4}$	...	3	0		
4	.. 12	5	2	2 $\frac{3}{4}$	...	3	6		
5	... 11	4	8	2 $\frac{1}{2}$	...	4	0		
		Head-gores.							
	IN.								
6	... 10	12		2 $\frac{1}{2}$	...	4	6		
7	... 9	10		2 $\frac{1}{4}$	...	5	0		
8	... 8	8		2 $\frac{1}{4}$	...	5	0		
9	.. 7	8		2 $\frac{1}{4}$	.	5	0		
10	... 6	8		2 $\frac{1}{4}$	...	5	0		
11	... 5	8	...	IN.		5	0		
12	... 3	8	...	1	...	2	...	5	0
13	... 2	8	...	2	...	2	...	5	0
14	.. 1	8	...	3	...	1 $\frac{3}{4}$	...	5	0
15	... 0	8	...	4	...	1 $\frac{3}{4}$	...	4	0
16	... 1	8	...	5	...	1 $\frac{3}{4}$	...	3	0
17	... 2	8	...	6	...	2	...	2	6
18	... 3	8	...	7	...	2	...	2	0
				8	Leech-tabling.				

Width of Seams at the Head. — The first and second seams next the throat to be 2 $\frac{1}{2}$ inches wide, and tapered down about 18 inches; the remaining seams 1 $\frac{1}{4}$ inches, and continued this width down to the foot-taper. The tablings at the throat to be suddenly turned in, to suit the hook, which is driven into the under part of the jaws of the gaff, to hook the throat of the sail.

Leech-tabling, 6 inches wide at the clue and peak, and 3 inches at the middle; the tabling at the clue made sudden, and the tabling at the peak about 6 or 8 feet down the taper.

Linings.—The after-leech is lined with one breadth of canvass, from the clue to one yard above the upper-reef. The *peak-piece* is one yard and a quarter in length, and the fore-leech or mast is lined with half a breadth of canvass, from the tack to the throat.

Reefs.—This sail has two reefs, 6 feet and 5 feet 6 inches, parallel to the foot, and small holes are made in the seams, across the sail, for reef-points, (for which see page 51). Holes are also made for the reef-criingles on the leeches, at the ends of the reefs; and two holes at the clue, for the clue or sheet-criingle. In the royal navy, the spanker has three reefs, banded, of one-fourth of a breadth.

Holes are made in the mast-leech, 27 inches asunder, for seizing the mast-leech to the hoops which encircle the mast, and a *hole* is made in every cloth in the head for attaching it to the hoops on the gaff.

NOTE.—It has become common to have the heads of mizens attached to hoops on the gaffs, and to draw them out by an outhauler.

Bolt-ropes.—The thicknesses are given in the "Table of the Circumference of Bolt-rope," page 44; and sewing them on is described at page 46. In roping round the clue, a good deal of slack canvass ought to be taken in, to take the strain off the holes, for the sheet-criingle.

Galvanized thimbles are stuck in the cringles at the clue, peak, neck, and tack; and also in the cringles made on the leeches, at the ends of the reefs.

MAIN AND FORE TRYSAILS.

Fore and main trysail gaffs, in sailing vessels, are generally fixtures, fitted with a goose-neck to work in an eye in the after-part of the truss-hoop. The heads of the sails are attached to hoops on the gaffs, and are drawn out by an outhauler; the fore-leeches are fixed to the lower masts to an iron jack-stay, similar to lower yards; a hoop with three eyes is driven on about two feet within the outer end of the gaff; the eye on the upper side of the hoop is for the peak-halyards, and the eye on each lower quarter for the vangs; a sheave-hole is cut outside of the hoop for the outhauler.

The *depth of the luff* of a main-trysail or a fore-trysail is determined thus:—Add the length of the mast-head, the distance of the truss-hoop below the hounds, the housing of the mast, and the height of the tack has to be above the deck—the

sum of which, subtracted from the whole length of the mast, gives the depth of the fore-leech.

The tack of the main-trysail, for a barque, stands about ten feet above the deck; and, in a poop-deck ship, the tack is 14 feet from the main-deck. For fore-trysails, the tack is 7ft. 6in. from the deck, or the height of the main-stay, where it crosses the fore-mast.

The after-leeches of the main and fore trysails, to look well, ought to be parallel to the leech of the spanker.

MIZEN-TRYSAIL.

In the Royal Navy, a mizen-trysail is occasionally used for the spanker in stormy weather, and made of No. 1 canvass. The fore-leech is nearly the same depth as the spanker, and the after-leech is three-tenths deeper than the fore-leech. The head has two-fifths of the number of cloths that are in the head of the spanker, and the length of the foot is such as to set all on board.

Dimensions for cutting-out a frigate's mizen-trysail.

				FT. IN.					
Head		-	-	-	14	6 equal to 8 cloths.			
Foot		-	-	-	27	0 equal to 15 cloths			
Mast-leech		-	-	-	36	0 tabled.			
After-leech		-	-	-	46	2 tabled.			
Cloths.		Foot-gores.		Mast-gores.		Width of Seams at the foot.		Length of taper.	
		IN.		FT. IN.		IN.		FT. IN.	
1	...	14	...	5	4	3	...	2	0
2	...	13	...	5	4	2 $\frac{1}{2}$	...	2	6
3	...	12	...	5	2	2 $\frac{3}{4}$	...	3	0
4	...	10	...	5	2	2 $\frac{1}{2}$	...	3	6
5	...	9	...	5	0	2 $\frac{1}{2}$	...	4	0
6	...	8	...	5	0	2 $\frac{1}{2}$	...	4	6
7	...	7	...	4	10	2 $\frac{1}{2}$	...	4	6
				Head-gores.					
8	..	6	...	3	...	2 $\frac{1}{4}$	...	4	6
9	...	5	...	3	...	2 $\frac{1}{4}$	...	4	6
10	...	4	...	3	...	2	...	4	6
11	...	3	...	3	...	2	...	4	0
12	...	2	...	3	...	1 $\frac{3}{4}$	...	3	0
13	...	1	...	3	...	1 $\frac{1}{2}$	...	2	6
14	...	0	..	3	...	1 $\frac{1}{2}$	...	2	0
15	...	0	..	3	...	9 Leech tabling.			

This mizen-trysail is extended like the spanker, the fore-leech being attached to hoops which encircle the trysail-mast: the head is bent to a gaff, and the foot is extended by the boom (to set all on board).

It has two *reef-bands*, 6 inches wide, parallel with the foot; the upper one is 12 feet up the fore-leech, and the other half-way between that and the foot. It also has two *strengthening bands*, one-third of a cloth broad, at equal distances asunder, between the upper reef and the head, which are stuck along the edges of the bands across the sail.

The after-leech is *lined* with one breadth of cloth, from the clue to four feet above the upper reef-band. The fore-leech is lined with half a breadth of cloth, and the peak with one yard and a half in length.

The *bolt-rope* for the mast-leech is $3\frac{3}{4}$ inches in circumference; for the head 2 inches, foot and after-leech $2\frac{1}{2}$ inches, and clue 4 inches. Holes on the mast-leech, three-quarters of a yard distant.

A BRIG'S TRYSAIL.

This sail derives its name from a small mast, just abaft the main-mast, termed a *trysail-mast*;* the throat or neck of the sail is fastened on to a hook driven into the under part of the jaws of the gaff, and is generally hoisted on a level with the truss-hoop, and the tack is brought within two feet from the boom. The head spreads within 18 inches of the hounds at the outer end; and the foot is spread upon the boom, extending within 4 or 5 feet of the sheave-hole at the outer end of it. The after-leech is about one-half longer than the depth of the fore-leech.

Gores.—The depth of the fore-leech, divided by the number cloths to the mast, gives the length of the regular gore per cloth; but, if the mast is cut with a round, the gores must be regulated similar to the mast-gores for the spanker, (see page 84, also the tables at the end).

* Trysail-masts are generally used in large two-masted vessels, termed *snows*, and are for the purpose of lowering and hoisting the gaffs, as also to receive the hoops for attaching the fore part of the sail called a "trysail," and hence the mast is named a *trysail-mast*. When the trysail-mast steps on to the deck, the given diameter is at the height of the boom; at the upper end the diameter is seven-eighths of the given diameter. The lower end is finished into eight squares or "cants," as far as the height of the trysail-boom, and above it is rounded: in the Royal Navy the lower end is fixed into a "toad's back" (a piece of cast-metal of that shape), secured on the deck with four bolts. The upper end is fixed into a chock, fitted between the trestle-trees. A saddle, supported by three cleats, is fitted to carry the boom.

Dimensions for cutting-out a frigate's mizen-course.

This sail is cut like a trysail or driver, and sets as such by the gaff on the mizen-mast.

		FT.	IN.	
Head	- - -	30	6	equal to 14 cloths.
Foot	- - -	27	6	equal to 15 cloths.
Mast-leech	- -	37	6	tabled.
After-leech	- -	57	0	tabled.
Head-gore	- -	14	10	
Foot-gore	- - -	0	0	

Cloths.	Foot-gores.	Mast.	Head-gores.	
	IN.	FT. IN.		
1 ...	6	37 6	IN.	
2 ...	5	—	16	
3 ...	4	—	16	
4 ...	3	—	16	
5 ...	2	—	16	
6 ...	1	—	16	
7 ...	0	—	16	Slack-seams.
8 ...	0	—	16	IN.
9 ...	0	—	16	... 1
10 ...	1	—	16	... 2
11 ...	2	—	16	... 3
12 ...	3	—	16	... 4
13 ...	4	—	16	... 5
14 ...	5	—	16	... 6
15 ...	6	—	16	... 7
			16	... 8

The seams are creased parallel, $1\frac{1}{2}$ inches broad through out the sail.

Canvass in the body of the sail, No. 2, 232 $\frac{1}{2}$ yards.

This sail has one reef, 7ft. 6in., parallel to the foot; the reef-band is 6 inches wide.

The after-leech is *lined* with one breadth of cloth five yards in length from the clue; the fore-leech with half a breadth of cloth, and the peak-piece one yard and a half in length. Holes in the mast three-quarters of a yard distant, and two holes in each cloth, at the head and in the reef. The clue is marled two feet each way.

The *bolt-ropes* for the mast-leech and foot are 3 $\frac{1}{2}$ inches in circumference; for the head 2 inches, after-leech 2 $\frac{3}{4}$ inches, and clue 4 inches.

Iron thimbles are stuck in the clue, peak, neck, and tack; also in the cringles at the ends of the reef-band.

CONSTRUCTION AND MAKING OF JIBS.

The *flying jib*, when used, is the foremost of all the staysails hoisted upon the fore-topgallant-stay, and the foot is extended by the jib-boom and prolonged by the flying jib-boom, (see sketch, page 96).

A *jib* is the foremost sail of a ship, being a large staysail extended upon a stay from the outer end of the bowsprit, prolonged by the jib-boom towards the fore-topmast cross-trees. In large American ships it seems to be usual to have two jibs upon the jib-boom in lieu of one large one; the *outer-jib* being extended from the end of the jib-boom, while the *inner* jib-tack is nearly half-way down between the bowsprit-cap and end of the jib-boom, and both jib-stays are led to the fore-topmast cross-trees. This plan is much to be recommended, as the inner-jib will answer for a storm-jib; and, besides, the two jibs are easier handled than one large jib. In cutters and sloops the jib is on the bowsprit, and extends towards the lower mast-head.

Among the head-sails, the jib is the most powerful sail for casting the ship or turning her head to windward, being, as it is, furthest removed from the ship's centre of gravity; and, moreover, there are few sails that are so much admired as the jib and mizen, when they stand well. When a vessel is close-hauled, or is in stays, with the sheet to windward, the jib having a *flat surface*, soon gives effect; while the jib, which has a strong girt across the sail from the clue to the stay, forming a hollow both above and below the girt-line, is not only longer in intercepting the wind, but is continually flapping, with a noise like a "peal of musketry," which must be exceedingly annoying.

It has been for many years deemed necessary to cut the fore-leech or luff with a roach, to obviate the girt-strain from the clue to the stay; but unless the roach be placed to receive the girt-strain to the clue, it will never set as it ought to do. The roach or curve should be sudden, opposite the pull on the clue, thence tapering in a curved form, approximating to the parabolic, towards the head and tack; and also, in order to provide further for the clue-girt strain, the taper of foot-seams should be about 2ft. 3in. deep at the tack and sheet, and graduated to 4ft. 6in. to 5ft. at the middle of the foot-seams.

The position or height of the clue of the jib will be according to the steave of the bowsprit, and the angle formed by the jib-stay and the fore-topmast. The flatter the jib-stay, or the

greater the angle the jib-stay makes with the fore-topmast, the longer is the foot-gore and the shorter the leech; and, also, the less the steave of the bowsprit, the shorter the length of the leech, and more foot-gore will be required. The clue, however, should be of such a height that the sheets may bring a fair strain across from the clue to the stay; and the foot formed with a round to prevent it blowing into a hollow. The rope on the foot should be sewed on slack, similar to a driver foot. Complaints are often made that jibs do not stand well in consequence of the clue being too low, and that they are constantly drumming with a slack leech when the sheet is carried aft.

Many attempts, at various times within the last thirty years, have been made to improve the plan of the present method of making jibs; and others, again, have attempted to construct jibs of a totally new arrangement of the cloths; as, for instance, the "Angulated Method" of Mr. Matthew Orr, the principle of which consists in a new arrangement, or combination, of the materials used, (see sketch, page 92). The inventor remarks:—"Their advantages are, to produce a more favourable effect of the power acting on them than what is produced by the old established method of construction, and consequently their more advantageous impulse on the vessel." The practical utility of the invention has been highly appreciated by a great many north country captains. Another plan was that of the late Mr. A. Taylor, sailmaker, of Newcastle-upon-Tyne, for diminishing the *foot-gore* by the use of a *gored* after-leech, whereby the foot stretches less; and hence the *round* on the stay is not so much as other jibs, and stands uncommonly *flat* (see sketch, page 95). Then, again, we had what was denominated the "Concentrated" (some called it the "Fantail") jib. This, like the "Angulated" jib, required no foot-gore, the cloths and seams tending to one point, or to the clue. It is a plan which gives great strength to the jib, but makes it awkward to repair, which was no doubt the cause of the system altogether falling into disuse.

There are also several other inventions which have not come much under the author's notice; therefore, he has had but little practice in cutting them. Those referred to above have been most commonly adopted. A description of each plan is given.

STANDING JIB.

The usual size given to the jib at the foot is the distance of the sheave-hole in the jib-boom (rigged outside of the bowsprit-

cap) to 23 inches, or the breadth of one cloth abaft the fore-topmast-stay, at 6 feet above the boom, which is the given height for the clue; for the leech, as many yards in length, with one more, as there are cloths in the foot; and for the luff or stay, it will be according to the quantity of foot-gore there is in the sail. When a plan of the fore-and-aft sails is made, similar to the sketch on page 96, the lengths of the three sides and depth of the foot-gore of the jib can be taken with accuracy; but a plan of a jib is easily drawn, by taking the angle of the jib-stay, and the lengths of the foot and leech, and constructing a triangle, from which the length on the stay and depth of the foot-gore will be obtained. Also, to receive the girt-strain from the clue to the stay, set off 3 inches to every cloth in the sail, opposite to the clue, from the line drawn from the tack to the head, then draw the curve through it from the tack to the head. By delineating the breadth of every cloth, the length of every gore may be found with precision (see dimensions for cutting one, page 37). This sail is made of No. 4 or 5 canvass. (For *seams* and *tablings* consult chapter 2, page 40).



The *clue-piece* is five yards (for large jibs), and the peak and tack-pieces are one yard, cut diagonally. For small jibs, the *clue-piece* is two yards. A *strengthening-band* is extended over the cloths, from the clue to the stay, so cut and sewed as when put on to be two-thirds of a cloth broad at the clue, and one-third of a cloth broad at the edge of the stay; the selvage on the canvass is kept next to the foot, and sewed close to a thread of the weft from the clue (see the shaded part on the sketch).

Two holes are made at the *clue*, *tack*, and *head*, for the cringles, and one hole is made in every yard up the stay.

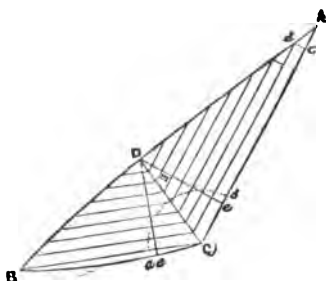
The *clue-rope*, which is spliced into the leech and foot-ropes, is one inch thicker than the leech-rope; the *tack-rope*, for large jibs, should be as stout as the clue-rope. In sewing on the bolt-rope no slack-cloth should be taken up, beyond what the stitch (*sinking in the contlines*) gathers, which easily stretches out again. When the foot is cut with a round, the foot-rope must be sewed on slack; a jib will never stand if tightly roped

Iron galvanized thimbles are put in the three corners.

* * The leech, foot, and stay ought to be stretched flat out before the sail is bent.

MATTHEW ORR'S ANGULATED JIB.

Having constructed a triangle, ABC , with the lengths of the three sides, and giving the proper round on the luff or stay, AB , as directed in page 91; then,



with C as a centre, describe an arc ab , and from the centres a and b , describe arcs intersecting in m ; draw CmD , which will bisect or equally divide the angle C . From the point D let fall the perpendiculars Dc , on AC and BC ; Cc equals the amount of the *seam gores*. Divide Dc into as many equal parts as there are cloths

required to fill up that width; and at the points of division draw lines parallel to AC and BC respectively, meeting in the line CD , from which the length of every gore to the scale of dimensions may be found with precision as the perpendiculars Ac of the small right-angled triangles $Ac d$, shown on the sketch.

Mr. Orr invented an instrument for calculating sails, and which he has termed the *Histiometer*.

Dimensions for cutting an Angulated Jib.

Leech, 36 feet; stay, 56 feet; foot, 26ft. 6in.; and, from C to D , $7\frac{1}{2}$ cloths. *Seam-gore*, $12\frac{1}{2}$ inches.

Upper part of Stay-gores.

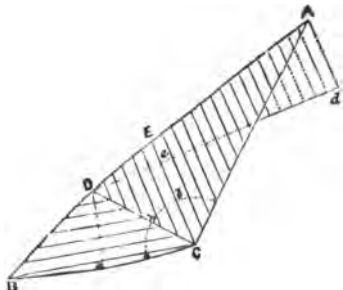
FT.	IN.		Cloths.
head 3	6	.....	1
3	6	.....	2
3	6	.....	3
3	6	.....	4
4	0	.....	5
4	0	.....	6
4	0	.....	7
3	0	.....	$\frac{1}{2}$
<hr/>			
29	0		

Lower part of Stay-gores.

FT.	IN.	
1	8	tack.
2	2	
2	2	
2	2	
2	6	
3	0	
3	0	
2	0	
<hr/>		
18	8	

KIPPING'S IMPROVED ANGULATED JIB.

The adjoining sketch for an *improved* or modified angulated jib, is here submitted by the author, from a well-grounded conviction of its utility and extraordinary strength. It differs from the preceding jib by having the seam which joins both parts of the sail at the cross-cut, CD , lower down than what it generally gives if the angle ACB were divided equally in two; it is placed according to where the strain at the clue, across the stay, will come. The seams, however, as a matter



of course, will be oblique from the leech to the stay, because the gores of both parts of the sail which join at the cross-cut must be all the same, and all the cloths below CD are parallel to the foot BC . By this mode of construction the cloths are *not* liable to split across the sail, and by the longitudinal threads and seams CE , CD , and CB , being well bound to the sheet, not only add strength, but cause the sail to stretch equally over every other part of the jib; hence the seams relieve the body of the sail from those heavy shocks which are often the cause of total destruction; and it is also made with less canvass than the old method.

The Method of Construction.

The lines representing the dimensions and shape of the jib being drawn, let a line be drawn from C to D , in the direction of the pull of the jib-sheets; then with any radius, Ca , describe an arc ab , intersecting CD in m ; make mb equal to ma ; join Cb and produce it to E , and the angle mCb will be equal to the angle mCa , and therefore CD bisects or equally divides the angle BCE . From D let fall the perpendiculars De on CE and CB respectively; produce De to any indefinite length, and from A let fall the perpendicular Ad on it. Divide Dd and De into as many equal parts as there are cloths required for the leech and De , and, at the points of division, draw lines parallel to CE to meet part of the stay, AD , and after-leech, AC and

C D; from the termination of each line, on the line C D, draw parallel lines to C B; from which the length of every gore to the scale of dimensions may be found.

Dimensions for Cutting-out.

Leech, 40 feet 6 inches; stay, 61 feet; and foot, 29 feet 6 inches. The *seam-gore* 2 feet 8 inches.

THE STAY.—Six and a half cloths between the tack and seam, or B to D, each whole cloth 2 feet 4 inches. Six and a half cloths above the seam, or D to E, each 9 inches. Fifteen cloths above ditto, or E to A, each 6 inches; the *leech-gores* each 1 foot 10 inches. When the sail is joined together, and the stay tabling rubbed down, the student will be surprised at not finding it a crooked stay, since it is as irregular as the gore, but, on the contrary, it will spread out on each side of the joint at D like a bird's wing.

CONCENTRATED JIB, EQUAL TO 11 CLOTHS (*see page 90*).

Leech	- 36 feet cut.	Stay-gores.	Cloths.
Stay	- 49 feet tabled.	FT.	IN.
Foot	- 22 feet, equal to 11 cloths.	3	4 peak. 1
Square	- 17 feet opposite to the clue.	2	10 — 2

DIRECTIONS.

In cutting from the square cloth, cut each cloth longer, to allow for *eating-up* in seaming. Cut from the square or 13th cloth both ways.

The round of the foot is formed by the selvage of the cloth, that is, by cutting a hollow off the canvass to join the next cloth. This tightens the foot, and prevents its shaking.

There is no waste in cutting a sail on this plan.

We think the description given of page 90 will be sufficiently intelligible, without a representation of this jib. A sketch of it will be found in the author's "Elements of Sailmaking," from which the reader will see it is not difficult to construct.

2	4	—	3
2	4	—	3
2	0	—	4
2	0	—	5
1	4	—	6
1	4	—	7
1	0	—	8
1	0	—	9
0	6	—	10
0	6	—	11
0	2	—	12
0	0	—	13
0	2	—	14
0	2	—	15
0	6	—	16
0	6	—	17
0	10	—	18
0	10	—	19
1	0	—	20
1	0	—	21
1	0	—	22

Some captains do not like the circular cloth sewed on the foot, they say it either curls up or keeps shaking; it will answer without the curved cloth.

ANDREW TAYLOR'S JIB.

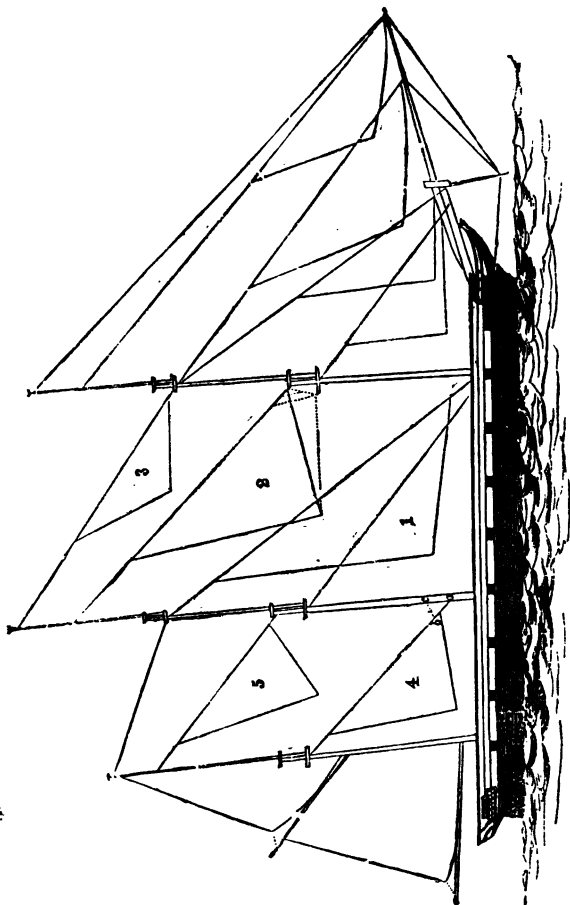
Another improvement in the construction of jibs was invented by the late Mr. A. Taylor, sailmaker, of Newcastle-upon-Tyne. The peculiarity of this invention consists of a *gored* after-leech for diminishing the *foot-gore*, which is of great importance, particularly of the jibs for schooners and steam-vessels, whose jib-stays lie in a flat direction, and consequently require a strong foot-gore. A reference to the annexed sketch will show how the foot-gore can be diminished at pleasure — the foot can even be cut straight by a thread, if required. By this mode of construction, the foot is made to stretch less; and the *round* on the stay, opposite to the clue, for the girt strain, is not so much as other jibs, and stands well.



The plan of this sail is made by first taking the lengths of the three sides, from a convenient scale of equal parts, and making the necessary curve to the stay and foot; then taking a common square, $a\ C\ b$, and placing the right angle C in the obtuse angle $A\ C\ B$, or clue of the sail; with the compasses take the widths of the cloths gored in the after-leech (from the same scale), and fixing one compass point in A and guiding the side of the square $a\ C$ to touch the other point of the compasses at right angles to it, and mark the point a ; then draw lines to the sides of the square, as shown on the plan, and the line $B\ b$, drawn from B at right angles to the side of the square $C\ b$, will give the foot-gore sought for. Divide $A\ a$ and $C\ b$, which are equal to the widths of the cloths in the leech and foot, into as many equal parts as there are cloths, and at the points of division draw lines parallel to $C\ a$, from which the lengths of the gores may be found. (See tables of jibs at the end.)

NOTE. — In roping the leeches of these sails, a little slack canvass must be taken in, so that it will come out flat, but yet take the strain. On similar principles, the *foot-gore* can be lessened in any fore-and-aft mainsail, by goring cloths being brought on the after-leech, which are taken off the cloths in the mast.

The following sketch exhibits the *staysails*, and the rest of the other fore-and-aft sails, that are most approved of for a ship or barque.



PLAN OF STAYSAILS, &C., FOR A BARQUE.

ON THE SHAPES AND SIZES OF STAYSAILS.

The usual plan of cutting staysails used to be to cut them with one gore all through the stay, and with a little broad seam in the foot, about $2\frac{1}{2}$ inches. The plan now is, to crease the same width of seams all through the sail; and, when the sails are spread for rubbing down the tablings, a little round to be in the stay and foot. But with regard to the various shapes of staysails, much depends on the position of the masts, and also where the different stays lead to. Main-topmast-staysails do not seem to answer well for ships that have the fore and main-masts too close together, as the after-leech chafes too much against the *fore* and *fore-topsail-braces*, to avoid which it is better not to have so much hoist to them as the others; the sail becomes then more of an acute-triangular shape. There are some craft to be seen which have done away with the *fore-gaff*, and have a spring-stay leading from the throat of the sail to the main-topmast-head; others, when the main-topmast-stay crosses the foremast about half-way up, have a mast to the sail, and the tack down, just to clear the main-stay. Of the main-topgallant-staysail, it seems to be all the fashion to have the stay leading to the fore-topmast-cap, so that some ships have a short mast to them, with the tack down in the fore-top. It appears to be all a matter of taste, but the majority like the sails cut with *jib-tacks*.

On first beginning to make staysails, many think it will be a difficult thing to measure for them, as they have not been used to them, especially the upper ones; but after drawing the plan of staysails for one ship, similar to the sketch (page 96), it will not be necessary to make any more drawings for vessels of about the same size, for it will be found that almost all the main-topgallant-stays have about the same angle, so that after obtaining the length of the stay, and allowing for drift, they are easily made. But for main-topmast-staysails you are obliged to measure for them, as every one has some slight difference in the lead of the stays.

The stay-sails drawn on the sketch (page 96) are of the most approved form, as they have more the appearance of jibs; and, the stays running parallel to each other, make the sails look well. The sails are also soon taken-in. To use the expression of the sailors, "Let go the halliards, and they come down of themselves," which is quite true in vessels having *wire* stays. Moreover, most captains like the stays to be nearly parallel to

each other, and invariably try as much as they can to have them so ; but this will, however, greatly depend on the heights of the masts and the distances they are apart.

The construction of the following staysails will be readily understood by reference to the sketch (page 96). The plan has been to make them all triangular, so that they may have the appearance of jibs, except it be the main-topmast-staysail, which some captains will have with a weather leech to it, in which case the main-topmast-stay leads well forward and crosses the fore-mast, some 13 or 14 feet up the mast. This, however, can be avoided, by having the stay rode down ; but others will not have any such thing done, as they like the stay to lead fair from the mast-head to the stem, and therefore this is the reason why some captains would have a mast-leech to this sail, which makes the sail clumsy, and even unsightly. It is a much better plan to cut it with a jib-tack and long-gore to the clue. (See page 9.)

FORE-TOPMAST-STAYSAIL.

This sail is triangular, cut with a little round in the stay and foot, and made of No. 1 canvass—(in the royal navy it is made of No. 5 canvass). It is extended on the fore-topmast-stay, and the foot is spread on the bowsprit. The leech is of the same depth as the hounded length of the fore-topmast (see page 8). Thus — a fore-topmast, hounded 27ft. 6in. or leech, 9 yards cut ; foot, 9 cloths.



Dimensions for Cutting-out.

Cloths.		Stay-gores.			Foot-gores.	
		FT.	IN.		IN.	
1	.....	5	4	.....	0	
2	.....	4	0	.....	1	
3	.....	3	8	.....	2	
4	.....	3	4	.....	3	
5	.....	3	2	.....	4	
6	.....	3	0	.....	5	
7	.....	3	0	.....	6	
8	.....	3	0	.....	7	
9	.....	3	0	.....	8	

The *clue-piece* is two yards long, and the *head* and *tack* are three-quarters of a yard. The *holes* on the stay are one yard apart: two holes are worked at the three corners for cringles with galvanized thimbles.

MAIN-TOPMAST-STAYSAIL.

See Fig. 1, page 96:—

This sail is triangular, cut with a little round in the stay and in the foot, and made of No. 3 or No. 4 canvass — (in the royal navy it is made of No. 5 canvass). It is extended on one of the main-topmast-stays, which reach from the hounds of the main-topmast to the deck, alongside of the mainstay, (see foot-note, page 9). The stays are *wire* in several ships.

The stay, on which the following sail hoists, crosses the foremast 8 feet from the deck; and the length of it, between the collar and after-part of foremast, where it crosses it, is 62ft. 9in. After an outline of this sail was drawn, the lengths of the sides were obtained as follows:—Stay, 54ft. 9in.; foot, 27ft. 6in.; and leech, 41ft. 6in. cut. This sail is cut from the *clue*.

Dimensions for Cutting the Gores.

Cloths.		Stay-gores.		Foot-gores.
		FT. IN.		IN.
1	.....	2 11	.....	10
2	.....	3 0	... ..	9
3	.....	3 0	.....	8
4	.....	3 0	.....	7
5	.....	3 1	... ..	6
6	.....	3 1	.....	6
7	.....	3 1	.....	5
8	.....	3 1	.....	5
9	.....	3 2	.....	4
10	.....	3 2	.....	4
11	.....	3 4	... ..	3
12	.....	3 4	.....	3
13	.....	3 6	.....	2
14	.....	3 10	.....	1
$\frac{1}{2}$	.....	2 5	.....	0

The *seams* are $1\frac{1}{2}$ inches broad all through; and the *tablings* are $3\frac{1}{2}$ inches on the leech and stay, and $2\frac{1}{2}$ inches on the foot. The *clue-piece* is $1\frac{1}{2}$ yard long, and *peak* and *tack-pieces* $\frac{1}{2}$ yard in length.

The *holes* on the stay are 27 inches asunder. Two holes are worked in the clue and peak, for sticking cringles through.

In *sewing* on the bolt-rope, a regular slack should be taken up in the stay; in the foot-rope only such slack as will come out flat, and the rope to take the strain; and in the leech, not any slack.

Iron galvanized thimbles are stuck in all the corners.

MAIN-TOPGALLANT-STAYSAIL.

Fig 2, page 96. This sail is triangular, cut with a small curve on the stay and foot, and made of canvass No. 5. It is extended on the main-topgallant-stay, between the hounds of the main-topgallant-mast and the foremast cap.

The length of the stay on which the following sail is hoisted measures 58ft. 6in.; and from an outline of the sail drawn on the plan, the lengths of the sides were obtained as follows:—Stay, 41ft. 6in.; foot, 21ft.; leech, 34ft. cut, or 32ft. 6in. tabled. It was cut-out from the leech.

Dimensions for Cutting the Gores.

Cloths.		Stay-gores.			Foot-gores.	
		FT.	IN.		IN.	
1	.....	3	3	.. ..	8	
2	.....	3	4	.....	5	
3	.....	3	4	.....	4	
4	.....	3	4	.....	4	
5	.. ...	3	5	.....	3	
6	....	3	5	.....	3	
7	.....	3	5	.....	3	
8	.....	3	6	.....	3	
9	.....	3	6	.....	2	
10	... ..	3	10	.....	1	
11	.....	3	10	.....	0	

The *seams* are 1 inch broad all through; and the *tablings* are 3 inches on the leech and stay, and $2\frac{1}{2}$ inches on the foot. The *clue-piece* is one yard long, and *peak* and *tack-pieces* are each half-a-yard in length.

The *holes* on the stay are 27 inches asunder; two holes are worked in the clue and peak, for sticking cringles through.

In *sewing* on the bolt-rope, a regular *slack* should be taken

up in the stay, and one inch in every cloth in the foot, but none in the leech.

Iron galvanized thimbles are stuck at the tack, peak, and sheet.

MIZEN-STAYSAIL.

Fig. 4, page 96. This sail is triangular. Sometimes it is cut with a mast-leech, but generally captains seem to like it cut with a jib-tack, similar to the other staysails. The number of canvass it is made of is No. 2 or 3. It is extended on the mizen-stay, between the hounds of the mizen-mast and main-mast, at 10 feet from the deck. In large ships, the mizen-stay is set up to a hoop round the main-mast, about 14 feet from the deck. The following sail was made for a barque of 500 tons. Its dimensions were these:—Stay, 29ft. ; foot, 22ft. ; and leech, 18ft. 6in., or 19ft. 9in. cut. It was cut from the leech.

Dimensions for Cutting the Gores.

Cloths.		Stay-gores.			Foot-gores.
		FT.	IN.		IN.
1	.....	1	2	.....	1
2	... ..	1	4	.....	1
3	.....	1	4	.....	0
4	.....	1	4	.....	1
5	.....	1	4	.....	1
6	.....	1	5	.....	2
7	... ..	1	5	.....	2
8	.....	1	5	.....	3
9	.....	1	6	.....	3
10	.....	1	6	.....	4
11	.....	1	7	.....	4
12	.....	2	0	.....	6
$\frac{1}{2}$	.....	1	0	.....	3

The *seams* are $1\frac{1}{2}$ inch broad all through ; and the *tablings* are 3 inches on the leech and stay, and $2\frac{1}{2}$ inches on the foot.

This sail is finished in every respect the same as the main-topgallant-staysail.

ROYAL-STAYSAIL.

Fig 3, page 96. This sail is triangular, and made of No. 7 canvass. It is extended on the main-royal stay, which is attached to the main-royal mast head, and leads to the fore-top-mast-cross-trees. These sails are seldom made for merchant vessels, but generally used in the royal navy. The following sail is for a frigate. The stay on which it is hoisted leads to

the hounds of the fore-topgallant-mast. Foot, 19 cloths; stay, 18½ cloths, and leech, 12 yards—the foot-gores, 7 feet *cut up*.

Cloths.	Stay-gores.		Foot-gores.
	FT.	IN.	IN.
1	3	0	2
2	2	11	2
3	2	10	1
4	2	9	1
5	2	8	1
6	2	7	0
7	2	6	1
8	2	5	2
9	2	4	3
10	2	3	4
11	2	2	5
12	2	1	6
13	2	0	7
14	2	0	8
15	2	0	9
16	2	0	10
17	2	0	11
18	2	0	12
19	2	0	13

The linings, &c., are similar to the preceding staysails.

MIZEN-TOPMAST-STAYSAIL.

Fig 5, page 96. This sail is triangular, and made of No. 6 canvass. It is extended on the mizen-topmast-stay, between the hounds of the mizen-topmast and the cap of the main-mast. The following dimensions were taken off the plan made for the barque here spoken of, viz.:—Stay, 31ft. 9in.; foot, 21ft.; and leech, 26ft. 3in., or 27ft. cut. This sail was cut from the tack.

Cloths.	Stay-gores.		Foot-gores.
	FT.	IN.	IN.
1	2	9	7
2	2	5	5
3	2	5	4
4	2	4	4
5	2	4	3
6	2	4	3
7	2	3	2
8	2	3	2
9	2	3	2
10	2	3	1
11	2	2	0

The *seams* are 1 inch broad, and *tablings* 3 inches on the leech and stay, and $2\frac{1}{4}$ inches on the foot.

This sail is finished similar to the main-topgallant-staysail.

MAIN-STAYSAIL.

This sail is made of canvass No. 1 or 2, and is in the form of a right-angled triangle. It is extended upon the main-stay, between the main and fore-masts, and cut so that the foot shall clear the boat; and the sheet is hauled aft to the gangway. This sail is seldom used, as ships generally carry a fore-trysail instead.

FORE-STAYSAIL.

This sail is made of canvass No. 1 or 2, and is in the form of a right-angled triangle. It is extended on the forestay, between the foremast and bowsprit.

Referring to rule at page 9 :—Suppose the head of the fore-course to be 28 cloths, Then $\frac{1}{2}$) 28 cloths,

$$\begin{array}{r}
 \text{---} \\
 14 \\
 \text{Add - } 2 \\
 \text{---} \\
 16 \text{ cloths in the foot.} \\
 \text{Leech—Depth of the middle of the fore-course, 27 feet.} \\
 \text{Stay-gore—} \quad 16) 27 (1 \text{ foot 8 inches.} \\
 \quad 16 \\
 \text{---} \\
 \quad 11 \\
 \quad 12 \\
 \text{---} \\
 132 (8 \text{ inches.} \\
 128 \\
 \text{---}
 \end{array}$$

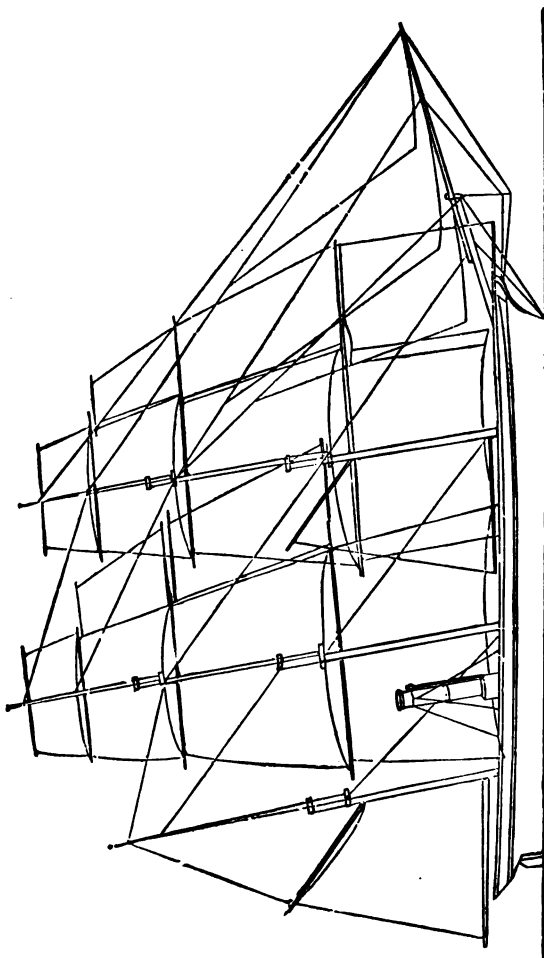
Linings.—The tack and peak pieces are half a yard each, and the clue-piece extends two yards up the leech.

Holes on the stay are 27 inches apart, and two holes in the clue and tack, for the cringles.

In sewing on the bolt-rope, a regular *slack* should be taken in the foot and stay, but none in the leech.

Iron galvanised thimbles are stuck in the corners: the peak is an earing.

The following plan represents all the square and fore-and-aft sails, excepting staysails, (which are shown on page 96), for an auxiliary screw barque.



AUXILIARY SCREW BARQUE.

PART II.

SECTION FIRST.

CHAPTER I.

MASTING, RIGGING, AND SAILS OF STEAM-VESSELS.

Remarks on the Auxilliary Application of the Screw-Propeller to Sailing Vessels in the Armed and Commercial Navies of this Country. — Mastng Steam-Vessels.—Dimensions of Masts and Spars for a Three-Decker, 131 Guns. — Description of the Armament of Gun-Boats. — Dimensions of the Masts and Sails for a Steam Screw Gun-Boat of 232 tons.—Dimensions of the Masts, Sails, &c., for a Steam Screw Collier.

WITHIN the last twenty or thirty years, a great change has taken place in the features of maritime affairs, by the auxilliary application of the screw-propeller to sailing-vessels; and, perhaps, the more especially so by its extension to the British navy generally. Although much may have been done in former years by our sailing vessels, and great as are the deeds they have accomplished, yet it is obvious that for the future they cannot form the chief body of our naval power, as the service required of them can be rendered with greater efficacy by the substitution of large steam-vessels, like the line-of-battle ships forming part of our present fleet. In the year 1856, there were in the navy 327 screw-vessels of all classes, from the powerful three-decker with her 131 guns and 1,100 men, to the small gun-boat of 2 guns and 25 men.

Although the principal propeller of a steam-vessel, generally, is her engines, it is nevertheless necessary that the vessel should be supplied with sails, in order to economize fuel when circumstances permit, as well as to have recourse to in case of need. Since, then, the consideration of economy requires that sail rather than steam should be employed whenever the wind will supply the required power, it is desirable to ascertain to what extent the sailing power may be carried in screw steam-ships and vessels. This will, of course, be determined principally by their stability and construction. Steam-vessels, being generally

of small beam in proportion to their length, it is therefore not practicable to have them masted as heavily as a sailing-vessel. The position of the engines often influences, also, the situation of the masts :—the length of which, moreover, must not be great, for too large a spread of sail would cause the vessel to incline more than is consistent with the proper working of the machinery. The lengths of a steam-vessel's masts must be proportioned to her beam and depth of hold, as well as her gradually diminishing stiffness or stability as she consumes her fuel. An advantage of having light masts is experienced when a steam-vessel is going head to wind ; while the resistance that heavy masts and yards offer to the wind is occasionally illustrated by vessels dragging their anchors and drifting on a lee-shore, and which have only been suddenly brought up, and saved from destruction, by cutting away their masts—the power of the engines on the water, in such a case, being inadequate to oppose the force of a strong wind. The spars must, then, be as light as possible ; and, since their importance as a propelling power is less than in a sailing vessel, it is advisable to get rid of the heavy tops and yards, with their attendant lumber of standing and running rigging. These considerations have led to the adoption of the fore-and-aft, or schooner rig in steam-vessels generally, which, admitting light spars and rigging, is better suited for this class of vessels. The nature of the rig must, however, depend in some measure upon the particular service the vessel is intended for. If intended as a packet, in which speed is the main object, and saving of fuel a minor consideration, then short light masts are best, being in such cases only carried as auxiliaries to the engines, and spreading just enough canvass to steady the vessel in a sea-way. But if the vessel is intended to trade to distant parts, such as Australia or India, or for war purposes, where long cruises have sometimes to be undertaken, then heavier spars are adopted, as in such a case, by lifting the screw, or disconnecting it from the engines, the vessel can avail herself of her sailing powers. As to the number of masts to be put into a steam-vessel, there seems to be no determined rule. Some long vessels have had as many as four, and even six (which is the number of masts in the *Great Eastern*), though the general number is three, and even two—this last number being often adopted in war-steamers, on account of leaving a clear space aft for working the pivot-gun. The mainmast in steam-vessels not unfrequently has to be placed in the space allotted to the engines and boilers, in which case, and when it comes too near

the fires, an iron leg has to be introduced to support the mast ; and, at other times, the mast is leaved in front, facing the heat. In screw-vessels it frequently happens that the shaft has to go through the heel of the mainmast. Recently, *iron masts* have been occasionally introduced ; but though they possess the advantages of strength and durability, and afford the means of ventilating the hold, their rigidity, and the impossibility of cutting them away in a case of emergency, combined with their great expense, have prevented them being brought into anything like general use. We need not extend these remarks further, to show that the lengths of the masts and yards of steam-vessels must bear some general relation to the dimensions of the vessel ; and the nature of the rig to the service in which the vessel is to be employed. By way of illustration, we subjoin the lengths of the spars for a screw line-of-battle ship :—

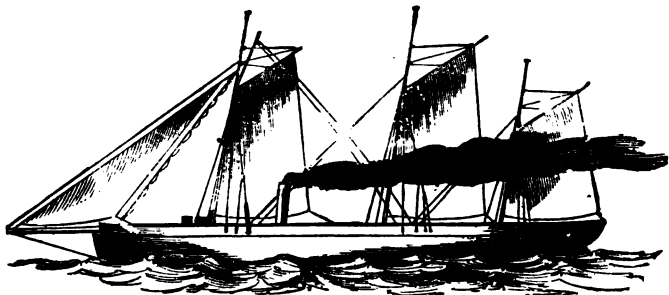
*Dimensions of the Masts and Spars of a Screw Three-Decker,
131 Guns.*

	FT.	IN.	IN.
Mainmast, extreme length above the upper deck	88	0	dia. 42
Main-topmast, extreme length - - - - -	73	0	— 22
Main-topgallant-mast, extreme length - - -	55	0	— 13
Main-yard, extreme length - - - - -	111	0	— 26½
Main-topsail-yard, extreme length - - - -	78	0	— 16½
Main-topgallant-yard, extreme length - - -	49	0	— 11½
Main-royal-yard, extreme length - - - - -	34	0	— 7
Fore-mast, extreme length above the upper deck	79	0	— 38
Fore-topmast, extreme length - - - - -	65	0	— 22
Fore-topgallant-mast, extreme length - - -	49	0	— 12
Fore-yard, extreme length - - - - -	96	0	— 23
Fore-topsail-yard, extreme length - - - -	68	0	— 15
Fore-topgallant-yard, extreme length - - -	43	0	— 10
Fore-royal-yard, extreme length - - - - -	30	6	— 6
Mizen-mast, extreme length above the upper deck	64	0	— 26
Mizen-topmast, extreme length - - - - -	52	6	— 17
Mizen-topgallant-mast, extreme length - - -	40	6	— 9½
Cross-jackyard, extreme length - - - - -	74	6	— 18
Mizen-topsail-yard, extreme length - - - -	54	8	— 12
Mizen-topgallant-yard, extreme length - - -	35	0	— 8½
Mizen-royal-yard, extreme length - - - - -	25	6	— 5
Bowsprit, from outside the knight-heads, extreme length - - - - -	52	6	— 40
Jib-boom, extreme length - - - - -	53	0	— 16

Spread of canvass, 9,760 yards. In all, 24,680 yards.

GUN-BOATS.

This fleet is, perhaps, one of the most wonderful of our recent improvements in naval warfare. It was brought into existence in an incredibly short time, and is a most formidable engine in shoal water, where a line-of-battle ship cannot reach. This will at once be perceived by the following description :—



The first-class of gun-boats is composed of screw-ships of 200 feet in length ; they carry six long 68-pounders, and are provided with engines of 360-horse power, and a crew of 100 men each. This class is intended as subdivisional ships.

The second-class are about 150 feet long ; they carry four 68-pounders, are provided with engines of 200-horse power, and the crew numbers 80 hands.

The third-class are about 100 feet long, of 60-horse power engines, armed with one 68-pounder pivot gun, one 32-pounder pivot gun, and two brass-howitzers (24-pounders) on the broad-side. This class is by far the most useful and numerous of the whole flotilla, their extraordinary light draught (generally averaging from 4 to 6 feet) enabling them to steam into the shallowest creeks and inlets, while their heavy armament renders them effective against the strongest forts. Above the rough-tree-rails, all round the vessel, are provided moveable wrought-iron plates, perfectly rifle-proof, and reaching about seven feet above the deck, so as to protect the men from the enemy's riflemen, in case of having to force the passage of narrow rivers defended by sharpshooters.

The fourth-class is also a useful flotilla for very shallow streams and close in-shore service. It comprises vessels of about 80 feet long, the engines averaging 20-horse power. Each boat carries two 32-pounder pivot guns amidships ; and

the crew usually numbers 36 hands, exclusive of officers. These boats are very little larger than the small steamers which ply upon the Thames, though they are certainly considerably broader, in order to admit of working the guns without danger to the craft. Their draught of water, with stores, ammunition, provisions, and guns on board, does not exceed from $3\frac{1}{2}$ to 4 feet.

The whole flotilla is provided with high-pressure locomotive boilers, to economize the limited space at the disposal of the engineer. Notwithstanding their small horse-power, the fleet will average in speed from seven to nine knots an hour.

Having described the power and armament of the gun-boats, of which there are about 200, it may be useful and interesting to describe their rig. They are three-masted cutter-rigged, with light and small spars. The dimensions of the masts, gaffs, and sails, are as follows :—

Dimensions of Masts, &c., for a Steam Screw Gunboat of 232 Tons.

Length between the perpendiculars, 106 feet; breadth extreme, 22 feet; depth of hold, 8 feet; power of engines, 60 H.P.	MAIN.	FORE.	MIZEN.
	FT. IN.	FT. IN.	FT. IN.
Length of the Mast, from Deck to Hounds	36 0	36 0	26 6
Length of Pole	12 6	12 6	9 3
Diameter of Mast	0 11	0 11 $\frac{1}{4}$	0 9
Length of Gaff	20 0	22 0	13 6
Diameter of ditto	0 5 $\frac{1}{2}$	0 5 $\frac{1}{2}$	0 4
Length of Spanker Boom .....	...	...	22 6
Diameter of ditto .....	...	...	0 7
Extreme Length of Bowsprit	18 3		
Length Outboard	13 6		
Diameter of ditto at Heel	0 7 $\frac{1}{2}$		
Ditto at Stem	0 8 $\frac{1}{2}$		
Ditto at End	0 6		

Dimensions of Sails, from the Plan.

—	Head or Stay	Foot.	Leech.	Mast.	Foot Gore.	Head Gore.
	FT. IN.	FT. IN.	FT. IN.	FT. IN.	FT. IN.	FT. IN.
Foresail	18 6	33 0	41 9	28 0	11 0	5 0
Mainsail	18 0	28 6	39 6	28 0	7 2	7 0
Mizen	11 6	20 6	26 6	18 6	5 6	4 6
Jib	35 0	19 0	22 0	...	8 0	
Fore-Staysail	34 0	17 0	27 6	...	1 8	

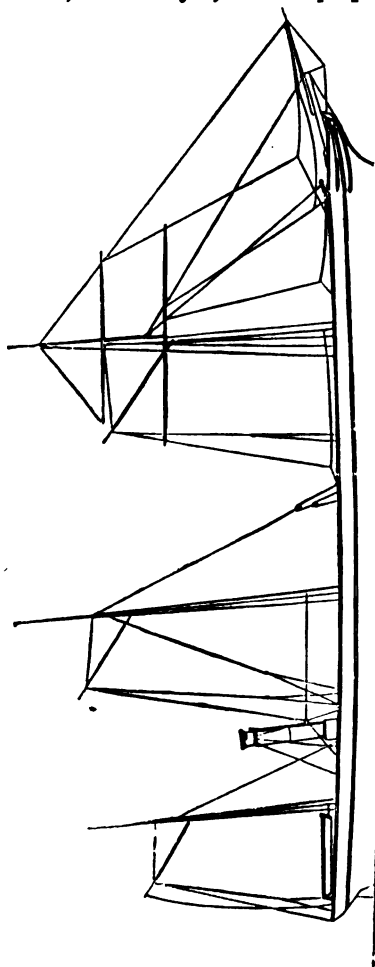
SCREW-COLLIER.

A *screw-collier* is a long, iron steam-vessel, chiefly employed in carrying coals to London and other ports, being in size from 600 to 1,200 tons burthen. These vessels are commonly rigged with three light masts, and a short bowsprit, which is sometimes prolonged by a jibboom; the lower-masts are mostly taunt, and the fore-topmast and topgallant-mast in one, the heel of which is made to fit close to the mast-head. The yards on the foremast are usually square, and lightly made, for carrying a square sail, set flying; a topsail; and sometimes a topgallant-sail; also, lower and topmast studding-sails. The fore-and-aft-trysails are generally made as large as the space for conveniently working them will admit, for they can be easily lowered down; and, if they were kept up, they would present but little obstruction in steaming head to wind. The bowsprit is rigged in a similar way to that of a schooner, and carries a fore-staysail and jib—and, sometimes, a large outer jib, for fine light winds. The masts are supported by *wire* shrouds and stays:—the main and fore by four, and mizen by three shrouds on each side of the masts. Some vessels have one shroud less to each mast. The foremost-end of each gaff is fitted to receive an iron parral (neatly covered with leather), formed as a clasp-hoop, which is made to compass the mast; on the after-part of which is welded a stalk or rod about one foot in length, with an eye to shackle on the throat-halyards.

As the principal design of an iron screw-collier is for burthen, it is necessary that the engines and boilers should be fixed as near as possible to the after end of the vessel, on account of leaving a clear space in the hold for cargo. By the adoption of long hatchways, considerable time is saved in shipping the coals and taking them out again. One of these vessels, carrying from 600 to 700 tons of coals, can be loaded in three hours, and discharged by steam cranes in seven hours. They are generally furnished with one small cabin aft, for the accommodation of the captain and mate; and a fore-cabin for the engineers, firemen, and crew. They are ballasted with water. The bottoms of most of them are laid with iron tanks for holding the water; but lately the bottoms of some newly-built vessels have been formed on the cellular tubular system, or double-bottomed, the space between the tubes affording capacity for the requisite quantity of water-ballast.

Screw-colliers (see sketch on next page) were first brought into use in 1852, in which year the *John Bowes*, a vessel of

550 tons, was built by an eminent iron-shipbuilding firm at Jarrow, on the Tyne, for the purpose of trading with coals



between that river and London. The idea of making use of steam and the screw in the coal-trade was at first received with distrust, and gentlemen of considerable experience in that business confidently predicted the failure of the experiment; but a trial of a few months proved that vessels of this class could be economically and successfully managed, and the *John Bowes* was followed before the close of the year 1852 by twelve other screw - colliers from the yard of the original builders. Encouraged by the success which attended the experiment, large numbers of iron screw - colliers, since the advent of the *John Bowes*, have been built on the Tyne and at adjacent ports, and iron screw - colliers have now assumed a prominent position in the conveyance of the great staple of the North to the metro-

politan market. In 1857, a new iron screw-vessel, the *William Cory*, of 1,200 tons burthen was built; this being

a larger size than had before been attempted. Below are given the comparative dimensions of the *John Bowes* and the *William Cory* :—

	<i>John Bowes.</i>			<i>William Cory.</i>	
	FT.	IN.		FT.	IN.
Length between the perpendiculars	160	0	...	255	0
Depth of hold	15	0	...	21	0
Extreme breadth of beam	26	0	...	35	0
Draught of water when loaded, aft	14	6	...	16	0
“ “ forward	13	6	...	15	0
Burthen in tons	550	...		1,200	
Coals, besides fuel, for engines, in tons	700	...		1,500	
Weight of water-ballast, in tons	100	...		250	
Power of engines (horse-power)	70	...		150	
Average speed per hour (miles)	8 to 9	...		10 to 12	

The given lengths of the masts are generally the heading, hounding, and housing : they are of similar form to single-tree masts without cheeks. The hounds are made square, the depth of the lower-cap or iron-band for receiving the heel of the topmast, and forms the trestle-trees, to which are attached the fittings for receiving the wire shrouds and stays. In three-masted schooner-rigged vessels, the foremast has two iron cross-trees, and the main and mizen masts each one :—the crosstrees are usually made of round iron, and curved aft ; the outer ends of them are open-eyes, to receive the topmast-rigging and back-stays, with screw-pins to confine the same. The after-crosstree is of one length, fitted on to two bolts welded on the after-part of the cap, and secured by screw-nuts, so that they can be easily removed without disturbing the iron-band. A thick bolt, about five or six inches long, is welded on each side of the iron trestle-trees or cap, to receive the socket on the inner-end of the foremast-crosstree. An eye or bracket is welded on the forepart of the cap, for the slings of the fore-yard ; and a strong bolt, with an eye and collar drove fore-and-aft-ways of the mast to receive the throat-halyard-block—the eye to project four to six inches abaft, so that the block may hang clear of the mast ; also, plates with eyes reversed, to receive blocks for the fore-boom topping-lifts, and having the same rake. On the after-part of the upper-cap are eyebolts for hooking an iron-bound double-block, for peak-halyards and outhauler, and for maintopmast-stay : the eyes to be clear of each other, so that the peak-halyard-block does not foul the stay in hoisting or lowering.

*Dimensions of Masts, Yards, &c., for an Iron Screw Collier
of 600 Tons.*

Names of the Masts, Yards, &c.		FORE.		MAIN.		MIZEN.	
		FT.	IN.	FT.	IN.	FT.	IN.
Lower Masts	Housing	17	1	17	0	7	0
	Deck to Hounds	39	11	44	0	34	0
	Head	8	0	8	0	5	6
Topmasts ..	Extreme Length	65	0	69	0	46	6
	To the Stops	21	0	21	0	16	0
	Pole	6	0	6	0	4	0
Yards	Extreme Length of the Squaresail-Yard	50	0	Arms.	2 6	...	...
	Extreme Length of the Topsail-Yard ..	38	0	2	0	...	...
	Gaffs	25	0	25	0	24	0
Booms	Pole	2	6	2	0	3	0
	Extreme Length .....	...	...	30	0	30	0
Bowsprit	Extreme Length	32	0	...	...	...	...
Jib-boom	Extreme Length	30	0	End, 1ft. 6 in.			

SAILS.

OUTER-JIB.

This sail is made of No. 6 canvass. It is the foremost-sail and hoists on the stay which extends from the jib-boom end to the stops of the fore-topmast.

Dimensions for Cutting-out (from the plan).

	FT. IN.		Cloths.	Stay-gores		Foot-grs.
	FT.	IN.		FT.	IN.	IN.
Leech - 41	0	tabled.				
Stay - 61	6	tabled.	$\frac{3}{4}$	...	4 6	.. 6
Foot - 29	0	equal to $13\frac{3}{4}$ cloths.	1	...	6 0	.. 8
			2	...	5 0	... 9
			3	...	4 6	... 10
			4	...	4 0	... 11
			5	...	4 0	... 12
			6	...	4 0	.. 13
			7	...	4 0	... 14
			8	...	4 0	... 15
			9	...	4 0	... 16
			10	...	4 0	... 17
			11	...	4 0	... 18
			12	...	4 0	... 20
			13	...	4 0	... 21

The *clue-piece* is two yards in length, and the *tack* and *head-linings* three-quarters of a yard long. The *seams* on the foot should be three inches broad, and should decrease to one inch on the hoist, (see page 89). *Bolt-rope*:—the rope on the hoist should be $2\frac{1}{4}$ inches in circumference; the rope on the leech 2 inches; and on the foot $1\frac{1}{2}$ inches. The *stay-holes* are one yard apart. Canvass, 115 yards

INNER JIB.

This sail is made of No. 3 canvass ; and bends with hanks to the stay, extending from the bowsprit-end to the lower mast-head ; the foot is made wide enough to spread the bowsprit. See sketch, page 111).

Dimensions for Cutting-out (from the plan).

	FT.	IN.							
			Cloths.		Stay-gores.			Foot-gore	
					FT.	IN.		IN.	
Leech - 34	9	tabled.			7	0	...	7	
Stay - 53	6	tabled.	1	...	5	6	...	8	
Foot - 24	6	equal to 11 cloths.	2	...	5	0	...	9	
			3	...	4	6	...	10	
Canvass in the sail, 86 yards.			4	...	4	5	...	13	
The <i>clue-piece</i> is one and a half			5	...	4	5	...	17	
yards in length, and the <i>tack</i> and			6	...	4	5	...	21	
<i>head-pieces</i> are three-quarters of a			7	...	4	5	...	24	
yard long. The <i>seams</i> on the			8	...	4	5	...	27	
foot should be 4 inches broad			9	...	4	5	...	30	
next the clue, and diminish to 3			10	...	4	5	...	32	
inches at the tack-seam.			11	...	4	5	...		

Bolt-rope.—The rope on the hoist should be $2\frac{1}{2}$ inches in circumference ; on the leech 2 inches, and on the foot $1\frac{1}{2}$ inches. The rope on the foot should be sewed on very round and slack (see page 90). The *stay-holes* are one yard asunder.

FORE-STAYSAIL.

This sail is made of No. 2 or No. 3 canvass : it is bent with hanks to the stay next before the mast. The depth of the leech is nearly the same as the depth of the foremost-leech of the foresail ; and there are as many cloths in the foot as will bring it clear of the foremast.

Dimensions for Cutting-out (from the plan).

	FT.	IN.
Leech - - 25	6	tabled.
Stay - - 40	6	tabled.
Foot - - 26	9	equal to 14 cloths.
Stay-gores, 2	4	each.
Foot-gores, 0, 0, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, inches, at the clue.		

Canvass in the sail, $71\frac{1}{2}$ yards

This sail has *one reef* at 4 feet up from the foot, and *two bowlines*—one bowline is 2 feet above the reef, and the other half-way between the reef and clue.

The *leech* is lined with a breadth of cloth from the clue to half-a-yard above the upper-bowline. The *bolt-rope* on the luff or hoist should be $2\frac{1}{2}$ inches in circumference, the rope on the leech $2\frac{1}{2}$ inches, and on the foot $1\frac{3}{4}$ inches. The *stay-holes* are one yard distant.

TOPSAIL.

This sail is made of No. 3 or No. 4 canvass. It is bent at the head to the topsail-yard, extending within 2 to 3 feet of the lifts, and the foot spreads to the inner sheave-hole in the fore-yard. By referring to the dimensions of the spars (page 113), the size of this sail is determined, thus :—

			Foot-gores.	
			IN.	
			1	
			2	
Head -	29	0 equal to $15\frac{1}{2}$ cloths.	3	
Reef -	34	0 equal to $18\frac{1}{2}$ cloths.	4	Leech-gores.
Foot -	40	6 equal to 22 cloths.	5	FT. IN.
Hoist -	22	0	6	— 1 9
Gore -	4	0	7	— 6 9
Middle -	18	0 cut—4 squares.	9	— 6 9
			12	— 6 9
			—	—
			4ft.	22 0

This sail has two *reef bands*. The close-reef is one foot above the half-way of the leech, and the other half-way between it and the head, and they extend underneath the leech-linings.

The *leeches* are lined from the clue to the earing with one half of a breadth of canvass ; and the *foot* is lined from under the leech-lining to the buntline-hole with a third or a halfbreadth.

The *reef-tackle cringle* is three-quarters of a yard below the close reef. The reef-tackle pieces are put on the aft side, and cover three cloths, in the direction of the head of the top-lining.

Also, a *top-lining* on the aft side, which for this sail is 7 cloths, and the cloths are cut $1\frac{1}{4}$ yards, and one cloth running up above the lower-reef, covering the centre of the sail that distance, or $3\frac{1}{4}$ yards.

One *buntline-hole* is made at one-third of the foot, on each side of the top-lining, and to take the foot-band end.

The *thickness of bolt-rope* on the leeches and along the foot is $2\frac{1}{2}$ to 3 inches, and for 15 to 18 inches up each leech, and along the foot, is parcelled and served ; the clues are turned-in to receive a thimble. (See page 50.)

Bolt-ropes.—Head rope, 2 inches in circumference; the foot, $1\frac{3}{4}$ inches; leech, $2\frac{1}{2}$ inches; clue-rope, $3\frac{3}{4}$ inches; peak, $3\frac{1}{2}$ inches; and mast, $2\frac{3}{4}$ inches.

Iron galvanized thimbles are stuck in the cringles at the reefs and in the four corners.

MAINSAIL.

This sail is made of No. 2 canvass. The head is bent to hoops on the main-gaff, and drawn out by an outhauler, and extends within 18 inches of the hounds. The fore-leech is attached to hoops which encircle the mainmast within 18 inches of the boom; and the foot spreads within 4 to 5 feet of the sheave-hole at the outer end of the boom, which hangs fore-and-aft abaft the mast. The size of this sail is determined from the dimensions of the spars for the vessel here spoken of, viz. :—

Dimensions for Cutting-out.

Head	-	-	-	21	6 equal to 11 cloths.
Foot	-	-	-	25	0 equal to 14 cloths.
Leech	-	-	-	45	0 cut.
Mast	-	-	-	32	6 tabled.

Cloths.	Foot-gores.		Mast-gores.		Head-gores.	Slack-seams.
	IN.		FT.	IN.		
1	...	9	...	11	5	
2	...	8	..	11	5	
3	...	7	...	11	5	
4	...	6	...	—	...	8
5	...	5	...	—	...	8
6	...	4	...	—	...	8
7	...	3	...	—	...	8
8	...	2	...	—	...	8
9	...	1	...	—	..	8
10	...	0	..	—	...	8
11	...	1	...	—	...	8
12	...	2	...	—	...	8
13	...	3	...	—	...	8
14	...	4	...	—	...	8

This sail has *three reefs*—6 feet, $5\frac{1}{2}$ feet, and 5 feet—parallel with the foot. The *linings*, *thicknesses of bolt-ropes*, &c., are the same as for the foresail.

SQUARE-SAIL.

This sail is cut square on the head and leeches, and made of No. 6 canvass. The head is hauled out to the outer sheave-hole in the fore-yard by the earings, and by sheets at the foot. A cringle is stuck in the centre of the head, to hoist up the sail

with the stay-foresail-halyards. The depth of this sail is nearly the depth of the fore-leech of the fore-sail.

Gores.—The foot is gored at the rate of one inch per cloth, increasing to each clue; four or five square cloths being left in the middle. It is much better to cut it square all through the foot. This sail is only used in fair winds, set flying.

Linings.—One yard of canvass is put on at each clue, half-yard at each earing, and half-a-yard against every cringle on the leeches. Sometimes the leeches are lined with half a breadth.

Bowlings.—Two to three bowlings are made on each leech:—the upper bowline-crinkle is on the middle of the leech, and the others are equally distant from that and the clue.

Galvanized thimbles are stuck in the four corners of the sail, and also in the centre cringle at the head.

MIZEN.

This sail is made of No. 3 canvass. The fore-leech is attached to hoops, which encircle the mizen-mast; and the head is bent to hoops on the gaff, and drawn out by an outhauler. The size of this sail is determined from the dimensions of the spars given for the vessel here spoken of, viz. :—

Dimensions for Cutting-out.

		FT.	IN.
Head	- - -	19	6 equal to 10 cloths.
Foot	- - -	25	6 equal to 14 cloths.
Leech	- - -	34	6 cut.
Mast	- - -	23	6 tabled.

		Foot-gores.		Mast-gores.			
Cloths.		IN.		FT.	IN.		
1	...	13	...	6	0		
2	..	11	...	6	0		
3	...	9	...	6	0		
4	..	7	...	6	0	Head-gores.	
5	...	5	...	—	—	IN.	
6	...	4	...	—	—	...	8
7	..	3	...	—	—	...	8
8	...	2	...	—	—	...	8
9	...	1	...	—	—	...	8
10	...	0	...	—	—	...	8
11	...	1	...	—	—	...	8
12	...	2	...	—	—	...	8
13	...	3	...	—	—	...	8
14	...	4	...	—	—	...	8

Slack-seams.
IN.

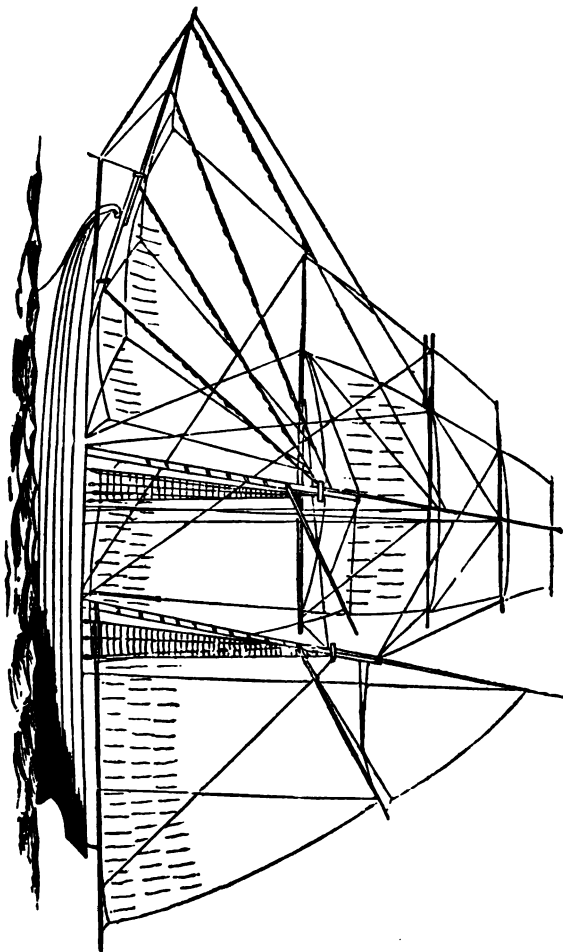
This sail has two reefs, 6ft. and 5ft. 6in., parallel with the foot.

FRENCH RIG OF SCREW-STEAMERS.

The adjoining sketch represents a style of rigging and sails recently applied to some of the small screw steam-vessels of the French mercantile marine. One of the prominent advantages of this sort of rig is, that the speed of a vessel in steaming head to wind will meet with less resistance than that of a vessel rigged the ordinary way, as she is divested of yards, gaffs, and cross-trees, which tend to obstruct the passage of the opposing force of the wind, thereby assisting the propelling power of the engines; the most beneficial results are also experienced in having light masts, and spreading the greatest quantity of canvass next the hull of the vessel:—this is more particularly felt in steam-vessels of narrow beam. Then, moreover, there is the advantage of working the sails with the greatest facility, and brailing them up against a head wind. The mode of rigging (see sketch) consists in equipping the vessel with three pole-masts and a short bowsprit. The masts are supported by two shrouds on each side of each mast, with one stay setting up to the stem, and one to the bowsprit-end. To the masts are attached triangular sails, or *shoulder-of-mutton sails*, being the same as lateen sails, but are thus called when the heads of them (then called fore-leeches) are laced to the masts. On the bowsprit is set a fore-staysail and a jib; and in addition to these sails they carry, sometimes, on the main and mizen-stays, staysails; and, when the wind is right aft, a square sail, called a cross-jack, is set on the foremast.



The following sketch represents the rigging and sails of a fast-sailing or clipper schooner (see tables at the end) :—



PLAN OF RIGGING AND SAILS OF AN IRON CLIPPER SCHOONER

CHAPTER II.

ON BOAT SAILS.

Description of Boats.—Boats' Spritsails. —Cutter, with Sprit-Mainsail and Jib. —Boats' Lugsails. —28-feet Cutter, with Fore and Mizzen Lugsails. —18-feet Gig, with One Lugsail. —Bermuda Schooner Rigged, with Short Gaffs. —Common Schooner-Rigged. —Settee-Sails. —Lateen Sails. —Xebec. —Sliding-Gunter Sails. —Herring Boat Sails.

Boats, as is well known, are small, open vessels, impelled on the water by rowing or sailing, and are distinguished by different names, according to their size and construction. The long-boat, or launch, usually the largest boat that accompanies a ship, is generally furnished with lugsail, boom-mizen, and a jib; her principal employment is to bring heavy stores or provisions on board; but for ships of war, they are sometimes armed and equipped for cruising at short distances, and are, therefore, mostly fitted to carry one large swivel gun. A pinnace, supplied to war ships for the accommodation of the lieutenants, &c., is generally furnished with one lug-foresail, boom-mizen, and a jib. The cutters of a ship are differently built from the preceding boats: they are what is called "clinch-built," that they may be as light as possible. Other boats are, a life boat, a dingy, a gig, a jolly boat, a felucca, a yawl, &c., &c.

BOATS' SPRITSAILS.

These sails are quadrilateral, and made of canvass No. 6 or 7. The fore-leeches are attached to their respective masts by lacing, reeved through holes made in them, and the heads are elevated and extended by sprits, or small poles, that cross the sail diagonally, from the mast to the peak; the lower end of the sprit rests in a wreath of



collar of rope called a snorter, which encircles the mast at the foot of the sail, (see adjoining sketch). The fore-leeches of the



main and fore-spritsails are 12 inches less than the depth from the sheave at the mast-head to the gunwale, with one or two gored cloths. The heads of these sails have an even gore of 12 to 14 inches to each cloth. The fore-leech of the mizen-sprit-sail is the depth from the sheave at the mast-head to

the gunwale, and has two to three goring-cloths: the head of it has seldom more than a gore of 11 inches to each cloth.

CUTTER, WITH SPRIT-MAINSAIL AND JIB.

Length of boat, 22 feet : breadth, 5ft. 6in.

Whole length of mast above gunwale, 12 ft. : mast-head, 1 ft.

Dimensions for Cutting-out the Sails.

MAINSAIL :—Head, $3\frac{1}{2}$ cloths ; foot, $5\frac{1}{2}$ cloths ; mast, 9 feet ; and leech, 16 feet.

Cloths.	Foot-gores.		Mast-gores.		Head-gores.
	IN.		FT.	IN.	IN.
$\frac{1}{2}$...	8	...	2	5	
1 ...	15	...	4	9	
2 ...	126	...	2	5	...
3 ...	94	..	—	—	6
4 .	...	...	—	—	10
5 ...	...	...	—	—	10

$23\frac{1}{2}$ yards,
No. 7 canvass.

JIB :—Leech, 9 feet ; stay, 11ft. 3in. ; foot, 7 feet or $3\frac{2}{3}$ cloths.

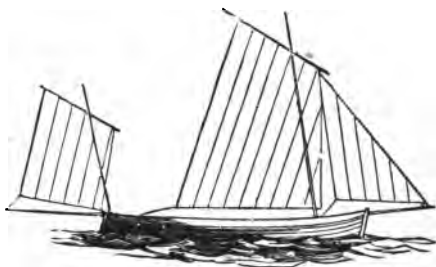
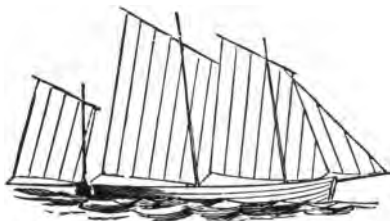
Cloths.	Foot-gores.		Stay-gores.	
	IN.		FT.	IN.
$\frac{3}{4}$...	2	...	2	1
1 ...	0	...	2	11
2 ...	0	...	2	11
3 ...	3	...	2	11

$6\frac{1}{2}$ yards,
No. 8 canvass.

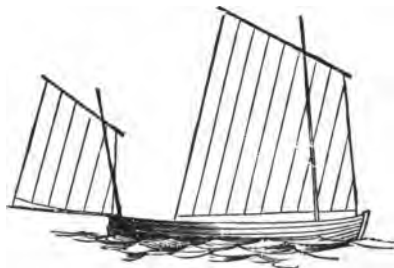
Small holes are made in the fore-leeches : those in the main and fore-sprit-sails are one yard, and those in the mizen are three-quarters of a yard asunder. Pieces of cord about half a yard long are used for reefing-points, which are fixed in the seams across the sail, at one-fifth of the depth of the after-leech from the foot. Holes, or small cringles, are made on the leeche at the reef, clue, tack, and nock ; and an earing at the peek to receive the upper end of the sprit.

BOATS' LUGSAILS.

These sails are quadrilateral, and made of canvass No. 6 or No. 7. The head is bent to a yard, which hangs obliquely to the mast at one-third of its length, and spreads the yard to about 4 inches of the cleats. The fore-leech is as deep as the length of the head, with two or three gored cloths. The head has about a six-inch gore to each cloth; the foot is gored to have a small sweep; and the after-leech is longer by one-half of the depth of the fore-leech, or the fore-leech is generally two-thirds the length of the after-leech. Two small holes are made in each cloth in the head; brass circlets are sometimes inserted in lieu of holes.



These sails have two reefs parallel with the foot; the upper one is half-way up the fore-leech, and the other is equally distant from that and the foot; and pricker-holes are made across the sail, in each seam, through which the reef-points are rove, and sewed down on the seam, "smack fashion" (see page 51). Small cringles are made on the leeches at each reef and the clue; and earings are made at the tack, nock, and peek. Small bolt-ropes are neatly sewed on round the edges of the sails.



28-FEET CUTTER, WITH FORE AND MIZEN LUG-SAILS.

LUG-FORESAIL :—Head, 11ft. 3in., or $5\frac{1}{2}$ cloths ; foot, 18ft., or $9\frac{1}{2}$ cloths ; mast, 15 feet ; and leech, 23 feet.

Dimensions of the Gores.

Cloths.	Foot-gores.		Mast-gores.			
	IN.		FT.	IN.		
$\frac{1}{2}$...	6	...	1	9	
1	...	12	...	3	5	
2	...	10	...	3	5	
3	...	8	...	3	5	Head-gores.
4	...	6	...	1	9	IN.
5	...	5	...	—	...	11
6	...	4	...	—	...	11
7	...	3	...	—	...	11
8	...	2	...	—	...	11
9	...	1	...	—	...	11
						Slack-seams.
						IN.
						3
						4
						5

No. 7 canvass, $49\frac{3}{4}$ yards.

LUG-MIZEN :—Head, 8 feet, or 4 cloths ; foot, 11ft. 2in., or, 6 cloths ; mast, 10ft. 6in. ; and leech, 15 feet.

Dimensions of the Gores.

Cloths.	Foot-gores.		Mast-gores.			
	IN.		FT.	IN.		
1	..	8	...	5	3	Head-gores.
2	...	6	...	5	3	IN.
3	...	4	..	—	...	8
4	...	3	...	—	...	8
5	...	2	...	—	...	8
6	...	1	...	—	...	8
						Slack-seams.
						IN.
						2
						3

No. 7 canvass, 22 yards.

18-FEET GIG, WITH ONE LUGSAIL.



Whole length of the mast
14ft. 9in. ; head, 1 foot.

Whole length of the yard,
10ft. 3in. ; arms, 9 inches.

Head, 8ft. 9in., or $4\frac{1}{2}$ cloths ;
foot, 12ft., or $6\frac{1}{2}$ cloths ;
mast, 9ft. 3in. ; and leech,
12 feet.

This sail has two reefs
parallel with the foot ; the upper one is half-way up the fore
leech.

Dimensions for Cutting-out.

Dimensions for Cutting out.

Cloths.	Foot-gores.		Mast-gores.		Head-gores	
	IN.		FT.	IN.		
$\frac{1}{2}$...	4	...	2 3	No. 7 canvass, 22 $\frac{1}{2}$ yards.	
1	...	6	...	4 6		
2	...	4	...	2 3		IN. 3
3	...	2	...	—		6
4	...	1	...	—		6
5	...	0	...	—		6
6	...	3	...	—		6

COMMON SCHOONER RIGGED.

A common schooner is a vessel with two pole masts and a bowsprit, whose mainsail and foresail are both suspended by gaffs, instead of being extended by sprits. The height of the nock of the mainsail above the water is equal to twice the breadth of the boat; and the foresail nine-tenths of the main. The heads of the sails are square, and the head of the foresail is usually three-fourths of the main. The length of the bowsprit equals three-tenths of the length of the boat.

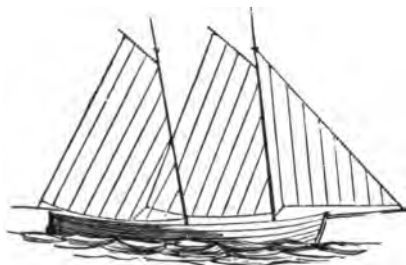


BERMUDA SCHOONER RIGGED.

The fore and main-sails of these vessels are sometimes called Bermuda sails, from their being narrow at the head, broad at the foot, and great hoist, with considerably more rake than common schooners. It is probable that this rig was substituted for lateen sails, on account of gaff sails being more effective when going free or in tacking; and, besides, this rig is not encumbered with long lateen yards.



BERMUDA SCHOONER RIGGED, WITH SHORT GAFFS.



Length of boat,
25 feet ; breadth,
6ft. 10in.

In Bermuda
rigged schooners,
the height of the
nock of the main-
sail is commonly
two and one-fifth
times the breadth
of the boat, and
the foresail twelve-

thirteenths of the main. The length of the main-gaff is from one-sixth to one-fourth of the length of the boat, and the fore-gaff is of the same length ; and the length of the main-boom equals to half the length of the boat. The length of the bowsprit equals two-fifths of the length of the boat. Rake of the main-mast to the foot, 4 inches, and the fore, 2 inches

Dimensions for Cutting-out the Sails.

MAINSAIL :—Head, 2 cloths ; foot, 6 cloths ; mast, 13 feet ; and leech, 16ft. 6in.

Cloths.	Foot-gores.		Mast-gores.		Head-gores.
		IN.		FT. IN.	
1	...	14	...	2 10	
2	...	12	...	2 10	
3	...	10	...	2 10	
4	...	8	...	2 10	
5	...	6	...	—	IN. 6
6	...	6	...	—	IN. 6

FORESAIL :—Head, 2 cloths ; foot, $5\frac{1}{2}$ cloths ; mast, 12 feet and leech, $15\frac{1}{2}$ feet.

Cloths.	Foot-gores.		Mast-gores.		Head-gores.
		IN.		FT. IN.	
$\frac{1}{2}$...	7	...	1 6	
1	...	14	...	2 11	
2	...	12	...	2 11	
3	...	9	...	2 11	
4	...	6	...	—	IN. 6
5	...	3	...	—	IN. 6

No. 7 canvass, 64
yds., in all the sails.

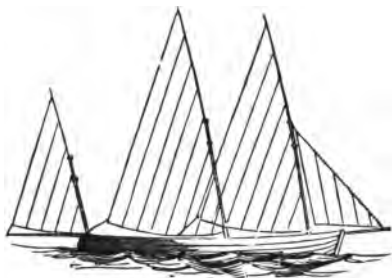
JIB :—Leech, 13 feet ; stay, $17\frac{1}{2}$ feet ; and foot, $9\frac{1}{2}$ feet, or 5 cloths ; foot-gores, 3 4, 5, 6, 7 inches ; stay-gores, 3 feet each.

EBEC, WITH THREE LATEEN SAILS.

These sails are triangular, and made of No. 6 or No. 7 canvass. The head has the same spread in relation to the yard as settees. The head of these sails commonly gore the breadth of the cloth, and the foot is cut square.

**THREE SLIDING GUNTERS AND A JIB.**

A boats' sliding-gunter sail is the same as the boats' lateen sail; but it is thus called, when the head of it (then called the fore-leech) is laced to a mast and topmast, the topmast being made to slide down the mast by means of hoops.

**SETTEE SAILS.**

These sails are quadrilateral, and made of No. 7 or 8 canvass. The head is bent to a lateen yard, which hangs obliquely to the mast, at one-third of its length, and spreads the yard to about six inches of the cleats. The leech is commonly five-sixths of the length of the head, and the luff one-fifth of the depth of the leech, or to the reef with the first cloth gored to the nock. The length of the head, divided



by the number of cloths in it, gives the length of each gore. The foot is gored to have a circular sweep. Two small holes are made in each cloth along the head through which the lacings are reeved; and a reef, at one-fifth of the depth of the leech from the foot.

HERRING-BOAT SAILS.

In the northern parts of Scotland, as Wick, Helmsdale, &c., large numbers of boats are employed in the herring fisheries: in Wick harbour alone there are from 800 to 1,000 fishing boats, all the same sort of rig, carrying two masts with lugsails. They vary in size from 24 to 34 feet in length of keel. In this example, the keel measures 31 feet, and the dimensions of spars are:—Foremast, 35ft. 3in; mainmast, 32ft.; foreyard, 16ft. 6in. The mainsail is generally one cloth less than the foresail, and about 3 feet less hoist, but some like both sails of one size. There are 8 cloths in the head and 10 cloths in the foot of the foresail: made with 85 yards of No. 4 canvass. The weather-bolt-ropes on the sails are about 4 inches in circumference, and after-leech 2½in.; the foot of the sail is rounded a little, 4in. gore at the tack, and about 12in. gore at the sheet; the head is gored 3 to 4 inches per cloth. The sails have six reefs, 30in. each apart, and a hook in the tack to which the cringle is hooked in reefing. The foremast is raked a little aft, and the mainmast stands about upright; but the fishermen differ in taste—some like both masts to be without any rake. The sails are hoisted by what they call a *tie*—that is, a rope about 30ft. in length and 4in. in circumference, with a knot on the end, put through an eye of an iron traveller which slides on the mast, and hooked on to the yard at about one-third from the throat of the sail; the tie is rove through a sheave-hole at 18 inches from the top of the mast; at the other end of the tie there is a double block, and at the gunwale of the boat a single block, through which the halliards are rove, the size of which is from 2½ to 2¾ inches. The sheets are made fast at the gunwale of the boat, and a single block at the sheet, to which the sheets are rove whenever the boat is put about. Whenever the boat is in stays or goes about, the sails are lowered down, (termed “dipping” the sails, by the fishermen,) and shifted to the other side of the mast, and the halliards put to the weather side, where they answer for back-stays. The fishermen say, “There are no boats that can go to the windward of theirs.” When they shoot their nets, the masts are lowered down so as to make the boat ride more at ease.

SECTION SECOND.

CHAPTER I.

ON DRAUGHTING AND CENTRE OF EFFORT OF THE SAILS.

Practical Geometry.—Practical Methods of Constructing Sails:—Main-course:— to Draw the Plan. — Maintopsail. — Main-topgallantsail. — Main-royal.—The Sails on the Fore and Mizzen Masts.—Jib.—Driver.

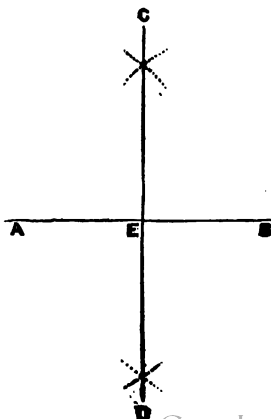
ON THE PRINCIPLES OF DRAWING PLANS OF SAILS.

In order to have a right understanding of draughting sails, geometry ought to be learned. To prepare the student for this, the most useful problems are herein briefly illustrated, and those who have leisure and opportunity will find themselves amply rewarded by a deeper study, whether it can be brought into immediate use or not; for the art of draughting presents difficulties to persons ignorant of it, which to the geometrician are easily surmounted. The following problems, being the most useful, have been selected.

I. To bisect a given line, AB—that is, to divide it into 2 equal parts.

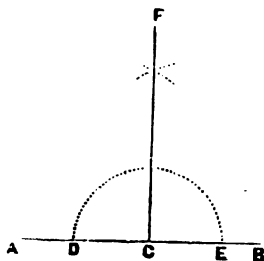
From the centres A and B, with any radius, describe two arcs intersecting each other in C and D, and draw the line CD, which will bisect the line AB in the point E, as required.

The two ends of the line AB are called centres, being made so to draw the arcs, the intersections of which being equally distant



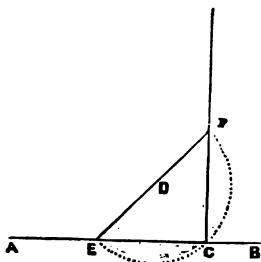
from the two ends, a line from C to D must pass through the centre of the line, and divide it equally.

II. *At a given point, C, in a given line, AB, to erect a perpendicular.*



From the given point, C, cut off equal parts, CD, CE, on the given line; then, making D and E centres, describe arcs intersecting in F; then join CF, which will be perpendicular, as required.

Otherwise.—When the point C is near the end of the line.

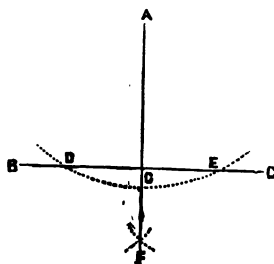


Draw the line AB, and mark a point, C, near the end of the line. From a point, D, assumed above the line for a centre, describe a circle passing through C, and cutting the line at E.

Draw a line from E through the centre D, and cutting the circle at F.

Join CF, which will be a perpendicular.

I.—*From a point, A, to let fall a perpendicular on a line, BC.*



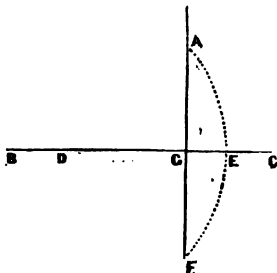
Draw the line BC, and choose a point, A, above it. From the point A, with a convenient radius, describe an arc, cutting the given line at the two points, D, E. Then, with any radius, describe two arcs, intersecting at F, and draw AF through G, which will be the perpendicular required.

Otherwise.—When the point is nearly opposite to the end of the line.

Draw the line BC, and fix the point A near the end of the line.

From the point, D, in the line BC, for a centre, describe the arc of a circle through the point A, cutting BC in E.

Now, from the centre, E, with the length EA, describe another arc below the line, cutting the first arc at F. Draw AGF, which will be the perpendicular to BC, as required.



PRACTICAL METHODS OF CONSTRUCTING SAILS.

Plans of sails are drawn to a scale of reduced proportion to the real dimensions, as the eighth or fourth of an inch to the foot, as may be convenient for the drawing. This sort of drawing is called *geometrical*, because it has no reference to a spectator, and is not designed to give the appearances of the sails *perspectively*, but only purposes to give the form and measurement of the surfaces of the sails in height and breadth, and also for rightly ascertaining the dimensions of the leeches, stays, and total amount of the sweep-gores on the head and foot, &c., of particular sails, as jibs, drivers, &c.

The whole of these operations are performed by means of a rule containing a scale of equal parts, a compass, a parallel ruler, and a square.

MAIN-COURSE.

To draw the plan. — Given the widths of the head and foot, the depth of the middle, the length of the leech, and the roach of the foot.

Head.—Set off half the breadth of the head, from the centre of the mainyard, both ways.

Depth.—Set down, from the centre of the yard, the depth of the middle perpendicularly, and produce it to the given roach of the foot.

Foot.—Draw a line perpendicular to the depth, or depth and roach on the same line, and set off from the middle, half the width of the foot both ways.

Leeches.—Join the places which are set off for the earings and clues.

Roach of the foot.—Through the depth of the middle of the foot draw a line parallel to the head, and set off both ways, from the middle, half of three-fifths of the breadth of the foot, from which places the roach is carried down to the clues.

MAIN-TOPSAIL.

To draw the plan.—Given the widths of the head and foot the height of the middle, and the roach of the foot.

Mast or hoist.—Set down the depth, from the centre of the topsail-yard to the centre of the mainyard, at right angles to both.

Head and foot.—Set off half the widths of the head and foot, from the centre of the yards both ways.

Leeches.—Join the places set off for the earings and clues

Roach of the foot.—Draw the arc of a circle through the roach set above the centre of the mainyard and the clues.

Close-reef.—Set down from the head half the hoist of the topsail, and between it and the head of the other reefs.

Hollow on the leeches.—Through the breadth of the sail at the head, the breadth at the lowest reef, and the breadth at the clues, pass the arc of a circle.

Middle-band.—Set down from the lower-reef half the distance between the reef and middle of the foot.

Reef-tackle pendant.—Set down to three feet (from a scale of equal parts) below the close-reef on the leeches.

Buntlines.—At one-third the breadth of the foot.

Bowlines.—At one-third the distance between the clue and reef-tackle.

The references to the other parts are obviously seen on sketch, page 72.

MAIN-TOPGALLANTSAIL.

To draw the plan.—Given the widths of the head and foot the height of the middle, and the roach of the foot.

Set down the *hoist*, from the centre of the topgallantyard, to the centre of the topsail-yard, at right angles to both.

Head and foot.—Set off half the widths of the head and foot from the centre of each of the yards.

Leeches.—Join the places set off for the earings and clues.

Roach of the foot.—Draw the arc of a circle through the height of the roach set up on the mast, above the topsail-yard and the clues.

MAIN-ROYAL.

To draw the plan.—Given the widths of the head and foot, the height of the middle, and the roach of the foot.

It is precisely the same way drawn as that of the preceding, excepting the roach, which is a great deal less.

The sails on the fore and mizen masts are likewise drawn in a similar manner to those on the mainmast.

JIB.

The plan of a jib is made by taking the lengths of the three sides and making the necessary curves on the stay and foot, and dividing the plan into cloths. See sketches on pages 91, 92, 93, &c.

DRIVER.

The method of drawing a driver, trysail, &c., is shown at page 10.

To draw the plan of sails for a new ship, it is necessary to have the dimensions of the hull, as :—

The distance between the foreside of the stem to the centre of the foremast.

The distance between the centre of the foremast to the centre of the mainmast.

The distance between the centre of the mainmast to the centre of the mizenmast.

The distance between the centre of the mizenmast to the outside of the taffrail.

The housing of the foremast.

“ mainmast.

“ mizenmast.

The step of the foremast above a straight line from the step of the mainmast.

The step of the mizenmast ditto.

The number of inches the foremast rakes to the foot.

“ “ mainmast “

“ “ mizenmast “

“ “ bowsprit rises to the foot.

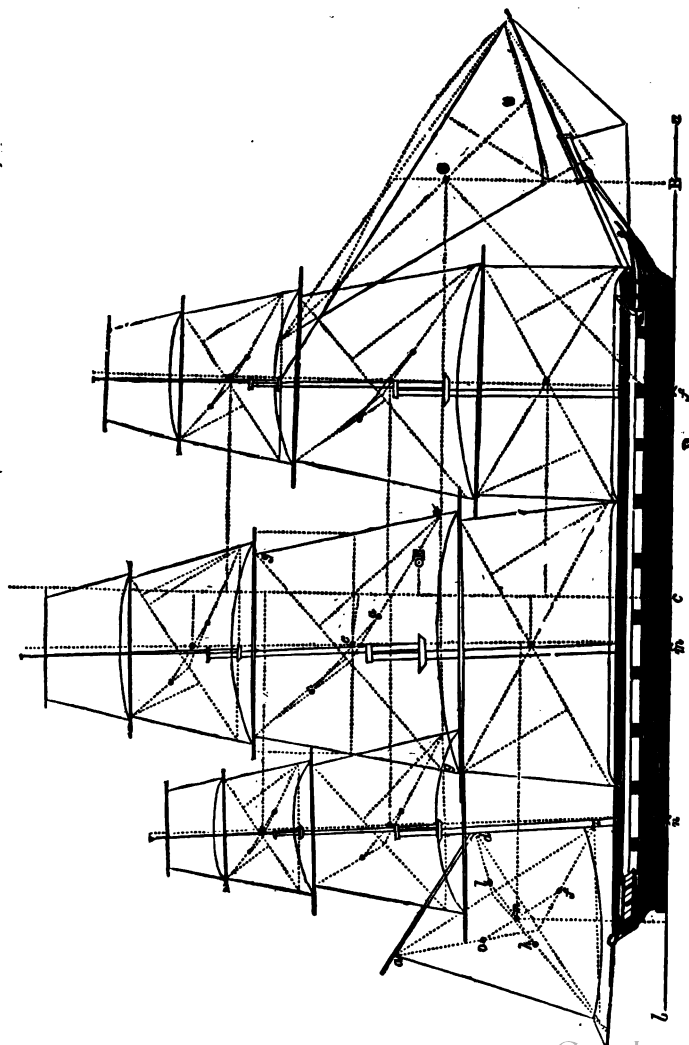
The height of the rail or gunwale.

“ topgallant-forecastle.

“ poop.

“ cathead or bumkins.

Also, the dimensions of masts, yards, gaffs, &c. (See sketch



POSITIONS OF THE CENTRES OF GRAVITY OF THE SAILS.

CHAPTER II.

ON THE CENTRE OF EFFORT.

To find the Positions of the Centre of Gravity of the Sails, according to their form. — To find the Centre of Effort of the Sails. — The Place of the Centre of Effort to produce the best Effect. — The Situation of the Point of Sail, as to Height, made by comparison with other Ships. — The Effect produced on the Sails, best determined by Experiments. — Balancing the Ship in a Wind. — The correct Relation of the Fore and After Moments of Sail. — Estimating the Power of a Sail to Raise or Depress a Ship's Head.

DEFINITION.

The point of sail or place in which the whole effort of the wind is supposed to be collected, is commonly called the **CENTRE OF EFFORT** of the sails; and is the point in which, if a single force were applied equally, and directly opposed to the force of the wind, it would destroy its effect, or produce the same result as when uniformly distributed; or as if, in this point, the centre of a single sail were placed with a surface equal to the sum of the surfaces of all the sails.

It is found in a manner similar to that by which we find the common centre of gravity of several bodies, only that in this case we consider the surface in place of the weight or magnitude of the body.

Before the centre of effort of the sails can be obtained, it is necessary to make a plan of the sails (see adjoining sketch), and find the centre of gravity of each sail to obtain the moments.*

The sails that are in general placed in the plan of the sails, are those which are most frequently used:—in square-rigged vessels, the fore and main courses, fore, main, and mizen topsails, fore, main, and mizen topgallant sails, driver, jib, and sometimes fore-topmast-staysail; and in fore and aft rigged vessels, as

* Thus, by the nature of the lever, when two bodies are in equilibrium about a fixed point C, they are reciprocally as their distances from that point;

As $A : B :: CB : CA$,

or $CA \cdot A = CB \cdot B$, that is, the two products are equal, which are made by multiplying each body by its distance from the centre of gravity. It is frequently necessary to refer to this power of a force to produce rotation, and accordingly the product just mentioned has received a particular denomination. It is called the *Moment* of the force round the axis. By moment is therefore meant the product of the force and leverage.

cutters, the mainsail, foresail, and jib (the second or third jib is commonly taken, as it is seldom that the first jib is set on a wind). The whole of these sails may not always be set; nor is the pressure of the wind, when it acts obliquely, and as the sail becomes more pressed, the same on both leeches; but since we obtain the moment of the sails, with a view only to compare with ships in which the quantity of sail is well proportioned to the stability, and in which the position of the point of sail is correct as to length, the unequal effect of the wind, and the number of the sails used (and these the principal sails), being the same in each case, will not affect the comparison.

If sails were rectangular, the centre of gravity of each sail would evidently be in the point where its diagonals intersect each other. But since most sails are either trapeziums or triangles, their centre of gravity must be found differently. If two sides of a triangular sail, as the jib, be bisected, and lines drawn from these points to the opposite angles, the intersection of the two lines will be the centre of gravity. The sails that are trapeziums with two equal sides, as the topsails, are formed into two triangles gqz and gqv , by drawing the diagonal gq ; the centre of gravity of each triangle is found, as for the jib; a line, ba , is drawn through the two centres of gravity, and the point in which it cuts the middle line of the sail, c , is its centre of gravity.

When the sail is a trapezium, as the driver, not having two equal surfaces on each side of the middle, it is first divided into two triangles, acd and acg , by drawing the diagonal ac ; the centres of gravity are found as before, and a line, hl , is drawn to pass through them; this figure is then formed again into two triangles, dga and dgz , by drawing the diagonal dg , from the two other angles d and g , the centre of gravity of these is found, and a line, of , drawn to pass through them; the intersection m , of the two lines of and hl , is the centre of gravity of the sail.

The areas of all the sails that are triangular are found by multiplying the base by half the height, as in obtaining the area of a common triangle; and the area of a trapezium, by forming it into two triangles, obtaining the area of each, and taking the sum of the two. The *moment*, as to height, is obtained by multiplying the height of the centre of gravity of each sail into the area; the sum of the moments of all the sails, divided by the sum of the areas, gives the height of the centre of effort. To obtain the distance of the centre of effort from the middle of the length of the water-line, multiply the distances of the centres of

those sails that are before it into their areas, for the sum of the moments before ; and the distance of the centres of those that are abaft into their areas, for the sum of those abaft ; when, if the difference between the sums of the two moments be divided by the sum of the areas, it will give the place of the centre of effort, either before or abaft the middle, according to which has the moments in excess.*

AREAS AND MOMENTS OF SAILS.

The area of the sails is the measure of their surface, or the space contained within the boundaries of that surface, and is estimated by the number of squares contained therein.

The area of a triangle and trapezium is found according to rules in books on mensuration. Thus—

I. *For the area of a triangle.*—Multiply the base by the perpendicular height, and half the product will be the area.

II. *For the area of a trapezium.*—Let two perpendiculars be drawn from the opposite angles to the diagonal. Multiply the sum of these perpendiculars by the diagonal, and half the product will give the area.

(By Rule I.)

JIB.

Perp. - - 24.6

937.5 area.

Stay - - 76

46 height of centre of gravity.

1480

56240

17266

374933

2)1874.6

43117.5 moment.

Area - 937.5 square feet.

937.5 area.

77.5 distance of centre of gravity from the middle

46866

656133

6561333

72643.33 moment before.

* See the Author's Treatise on the Elements of Sailmaking, page 143.

(By Rule II.)

FORE-COURSE.

Perps. - - $\begin{cases} 20.5 \\ 20.5 \end{cases}$ $\begin{matrix} 994.25 \text{ area.} \\ 26.6 \text{ height of centre of gravity.} \end{matrix}$

Sum - - - 41.0 $9)596550$

Diag. - - - 48.5 $\begin{matrix} 662833 \\ 596550 \\ 198850 \end{matrix}$

2050

3280

1640

2)1988.50

26513.33 moment.

Area - - 994.25 square feet.

994.25 area.

40.5 distance of centre of gravity from the middle.

497125

397700

40267.125 moment before.

(By Rule II.)

FORE-TOPSAIL.

Perps. $\begin{cases} 28 \\ 20 \end{cases}$ $\begin{matrix} 49.5 \text{ diagonal.} \\ 48 \end{matrix}$ $\begin{matrix} 1188 \text{ area.} \\ 56.6 \text{ height of centre of gravity} \end{matrix}$

Sum - - 48 3960 $9)3564$

1980

3960

2)2376.0

7128

5940

Area - - - 1188. square ft.

66924.0 moment.

1188 area.

40.6 distance of centre of gravity from the middle.

9)3564

3960

4752

47916.0 moment before.

(By Rule II.)

FORE-TOPGALLANTSAIL.

Perps.	{ 13	510 area.
	{ 17	85.5 height of centre of gravity
Sum -	- 30	2550
Diag.	- 34	2550
		4080
	2) 1020	
		43605.0 moment.

Area - 510 square feet.

40.16 distance of centre of gravity from the middle.
510 area.

40166
2008333

20485.00 moment before.

(By Rule II.)

MAIN-COURSE.

Perps.	- { 24	1530 area.
	- { 27	29.8 height of centre of gravity.
Sum -	- 51	9) 4590
Diag.	- 60	
		5100
	2) 3060	13770
		3060

Area - 1530 square ft.

44880.0 moment.

1530 area.

9 distance of centre of gravity from the middle.

13770 moment abaft.

(By Rule II.)

MAIN-TOPSAIL.

Perps.	{ 22.5	55.8 diagonal.	1494 area.
	{ 31.5	54	62.5 height of centre of gravity
Sum -	54	2213	7470
		27666	2988
			8964
	2) 2988.0		

93375.0 moment.

Area - 1494 square feet.

MAIN-TOPSAIL CONTINUED.

1494 area.

10.5 distance of centre of gravity from the middle.

7470

1494

15687.0 moment abaft.

(By Rule II.)

MAIN-TOPGALLANTSAIL.

Perpa. { 14
 { 18

592 area.

94.5 height of centre of gravity

Sum - - 32

2960

Diag. - - 37

2368

5328

224

96

55944.0 moment.

2)1184

Area - 592 square feet.

592 area.

12 distance of centre of gravity from the middle.

7104 moment abaft.

(By Rule II.)

DRIVER.

Perpa. { 26 42.5 diagonal.
 { 20 46

981.3 area.

30.5 height of centre of gravity

Sum - 46 2560

49066

17066

2944000

2)1962.5

29930.65 moment.

Area - - 981.3 square feet.

981.3 area.

52 distance of centre of gravity from the middle.

19626

490666

51029.5 moment abaft.

(By Rule II.)

MIZEN-TOPSAIL.

Perps.	{ 15·3	728·291	area.
	{ 22·5	55·6	height of centre of gravity.
		728·291	
Sum	- 37·8	9)43697500	44·3 distance.
Diag.	- 38·5		
		48552777	9)21848750
	18916	364145833	
	302666	3641458333	24276388
	1135000		291316666
		40541·56944	mom. 2913166666
	2)1456·58		
			32287·5972
			mom. abaft.
Area 728·291 square feet.			

(By Rule II.)

MIZEN-TOPGALLANTSAIL.

Perps.	{ 10	25·5 diagonal.	293·25 area.
	{ 13	23	79·3 height of centre of gravity
Sum	- 23	765	9)87975
		510	
			97750
		2)586·5	263925
			205275
Area	- - -	293·25 sq. ft.	23264·500 moment.

293·25 area.

46 distance of centre of gravity from the middle.

175950
117300

13489·50 moment abaft.

From the calculations, the following data is given to determine the position of the centre of effort of the sails, there being two co-ordinates requisite to fix the place, the one measured from the vertical line, parallel to the load water-line, and equal to 5·1 feet; the other, on a perpendicular to the load water-line, and equal to 50·61 feet; and the point where these intersect, marked E on the sketch, denotes the position of the centre of effort. See Rule at the bottom of page 136.

CENTRE OF EFFORT.

Species of Sails.	Areas.	Moments.	Moments before.	Moments abaft.
Jib	937·333\$	43117·333\$	72643·333\$	
Fore-course...	994·25	26513·333\$	40267·1250	
Fore-topsail..	1188·	66924·0000	47916·0000	
F.-topgal-sail	510·	43605·0000	20485·0000	
Main-course..	1530·	44880·0000	.....	13770·
Main-topsail.	1494·	93375·0000	.....	15687·
M. topgal-sail	592·	55944·0000	.....	7104·
Driver	981·333\$	29930·666\$	.....	51029·3\$
Miz.-topsail..	728·291\$	40541·569\$	.....	32287·597
M. topgal-sail	293·25	23264·5000	.....	13489·5
Sum.....	9248·458\$	468095·4027	181311·458\$	133367·43

Height of centre of effort above the } $\frac{468095\cdot40}{9248\cdot458} = 50\cdot61$ feet.
 water line ... -

Centre of effort before the } $\frac{181311\cdot4583 - 133367\cdot43}{9248\cdot4583} = 5\cdot1$
 middle of water-line, taken
 from the fore-part of the
 stem to the after-part of
 the stern-post.....

Relative proportion of the fore } $\frac{133367\cdot43}{181311\cdot4583} = \cdot73$, or 1 : $\cdot75$.
 to the after moments

The determination of the position of the centre of effort by the foregoing rule, is made under the supposition that the sails are plane surfaces; while by the pressure of the wind the whole assume a curved surface, by which the centre of effort is carried further aft, which in a degree causes the ardency to increase with the force of the wind; and the helm, which may have been a-lee in light winds, may be carried a-weather as the wind increases. The inclination of the ship, by the same cause, will increase the ardency; but these effects are not necessary to be considered in making the calculations, as, when the causes are known, the ardency may be corrected by trimming the sails. The centre of the effort of the sails, to produce the *best effect*, must be higher or lower according as the ship is more or less full at the load water-line, compared with the fulness of the

body at the extremities below the water. Ships that are full at the load water-line, and clean below, at the extremities, require the higher masts.

The situation of the point of the sail, as to height, affects the ship more or less according as the wind is aft; and, to determine its place, the direct and vertical resistances on the fore and after bodies are calculated. These results, however, cannot be obtained without considerable labour, owing to the extent of the calculation required; and for this reason they are seldom made by constructors, who, in general, rest satisfied with making a comparison with other ships, and placing the point of sail according to their judgment of the form of the body.

If the correct place of the point of the sail were determined with the sails that are generally taken into account for obtaining the moments, it would seldom be the point of sail when the wind is abaft the beam, for the studding and other sails are frequently set according to circumstances; and when the wind is right aft, it acts with full effect only on part of the sails; consequently, it would be impossible to adjust this point by the sails commonly taken into this account, so as to produce the best effect in propelling the ship under all circumstances. The variable sails ought therefore to be adjusted when they are set, according to the judgment of the officer; and it will be found that a greater rate of sailing will sometimes be obtained by taking in the top-gallant or top-studding sails. The effect produced, however, would be best determined by experiments made on the ship in smooth water, by an instrument that would indicate the trim, and show if either extremity was depressed from it.

The centre of effort of the sails, as to length, requires to be more or less forward, (before the common centre of gravity of the ship,) according as the ship is less or more full forward, compared with the fulness of the body aft, and likewise according as she is less or more by the stern. Those ships that are cleanest at the foremost extremity, and the least at the stern, will require the masts the farthest forward. It is therefore desirable for ships that are sharp at the foremost extremity to have a greater difference of draught of water; with the excess aft, to avoid, when the centre of effort is in its right position, having the masts further forward than the position in which the pressure of the water on the body can afford adequate support.

By attending to the position of the centre of effort of the sails, we may, by modifying their arrangement, if necessary, succeed

in balancing the ship in a wind ; but to produce such a disposition of the sails as may conduce to facilitate the working of the ship, there must be a correct relation between the moment of sail before and abaft the centre of gravity of the ship, or axis of rotation, which may not be the case, though the ship may be properly balanced when by the wind.

When the ship is in stays, a certain and reciprocal effect should be produced by the sails forward and aft, as the quality of working depends, in a great measure, on properly proportioning the fore and after sails. If the moment of sail be too powerful forward, and the sails be not worked quickly, the mean result of the water will pass to the lee quarter, the ship will fall off before she has recovered her way through the water, and considerable time will be lost before she can be brought by the wind ; or, if not powerful enough, the ship will not pay off, but remain head to wind, and get stern-way. If, on the contrary, the after-movement be too powerful, the ship may come to before head-way is obtained, and the head sails are brought to act. These inconveniences in working the ship may be prevented, to a certain extent, when there is not too great an influence produced by the excess of either of the moments, by an attention to the trim of the ship, and to the bracing of the yards. This, however, must not be depended on, since, to produce this, the ship may be brought out of her proper trim, and may be made uneasy ; but we must attain, as near as possible, the correct proportions, by an attentive comparison of the fore and after moments of ships that work well, with other elements upon which the placing of the sails depends.

The relation which the fore and after moments should bear to each other, can be determined only by examining their relation in a number of ships. In a ship that had a strong tendency to come-to in stays, the fore moment, from the middle of the length of the water-line, was to the after moment as 1 : .84 ; while, in a ship that was found to fall-off in stays, the fore moment was to the after moment as 1 : .66. The comparative moments of several other ships that were found to work well, according to the reports given by experienced officers on board of them, varied from 1 : .72 to 1 : .77.

It would appear, therefore, according to the experience we have obtained from the working of good ships, that the relation of the moments should be somewhere between the two limits ; and, having determined this, which may be done with more certainty by examining the moments of a greater number of ships,

any little disposition to come to, or fall off, may always be corrected by an attention to the trim, and that without affecting any other quality of the ship.

POWER OF A SAIL TO RAISE OR DEPRESS A SHIP'S HEAD.

In estimating the power of a sail to raise or depress a ship's head, according to the position of the centre of gravity of the sail:—Let CS, the jib (see sketch page 134), be a line passing through the centre of gravity, C. Suppose a plumb-line drawn through the centre of gravity of the section of the ship and water, intersecting the water-line, taken from the fore-part of the stem to the after-part of the stern-post in *c*. Through C, the centre of gravity of the sail, draw DC, perpendicular to the sail, CB perpendicular to the water-line, and CS, in the plane of the triangle CBD.

Then, if DC be the force of the wind against the sail CS, then BD is the force generating her progressive motion, and BC is the force lifting the ship upwards. Now, the force, DB, acting at C, in direction BD, endeavours to turn the ship round an axis passing through *c*, with a force which is equal to the absolute force, $BD \times$ by the distance CB, or $CB \times BD$; and this is the force by which her head is depressed. Likewise, the force BC, in direction BC, endeavours to turn the ship round an axis at *c*, on the contrary way, and that with the force $BC \times$ distance Bc, or $BC \times Bc$; and this is the force that raises her head. Therefore, the force to raise her head is to the force to depress it as $CB \times Bc$ to $CB \times BD$, or Bc to BD.

Hence, if the point D fall before *c*, then the sail endeavours to raise the ship's head; if it be behind *c* it endeavours to sink it; if it be in *c*, it will keep her steady. The height of the sail, CS, contributes nothing to her progressive motion; and the same ratio of the absolute to the progressive force remains still as CD to DB.

TO FIND PROPORTIONS FOR PLACING MASTS IN VESSELS.

By taking the distances of the masts in other nearly similar vessels, the performances of which are known, or whose sails have been properly balanced, and the length of the load water-line, we are enabled to find the proportions for placing the masts in any similar ship or vessel. Thus:—Referring to sketch on page 134, the length of the load-water line equals 138·5 feet; the distance of the centre of foremast from the stem 28·25 feet; the distance from *f* to *m* 51 feet; the distance from *m* to *n* 34·75 feet; and from *n* to the stern-post 24·5. Here, $\frac{138\cdot5}{2} - 28\cdot25 = 41$, the distance the centre of foremast is before the middle, *c*; and $\frac{41}{138\cdot5} = \cdot296$, the proportion as to the length of the load water-line the centre of foremast is before the middle. Again, the distance of *m* from the stem equals $(28\cdot25 + 51) = 79\cdot25$, and $79\cdot25 - 69\cdot25 = 10$, the distance of centre of mainmast abaft *c*; and $\frac{10}{138\cdot5} = \cdot072$ the proportion in terms of water-line for mainmast abaft *c*. Finally, the distance the centre of mizenmast is abaft *c* equals $34\cdot75 + 10 = 44\cdot75$, and $\frac{44\cdot75}{138\cdot5} = \cdot323$, the proportion for multiplying the length of the load water-line of any other similar vessel for placing the mizenmast. As for example:—Suppose the length of the load water-line of a ship to be 140 feet; then $140 \times \cdot296 = 41\cdot44$, the distance the centre of foremast before the middle *c*; and subtracting 41·44 from half the length of water-line or 70, gives 28·56, the distance the centre of foremast has to stand from the stem. And, for the distance between the foremast and mainmast, multiply 140 by $\cdot072 = 10\cdot08$ the distance the mainmast is abaft *c*, and $(10\cdot08 + 70) - 28\cdot56 = 51\cdot62$ from *f* to *m*.

TABLES

OF THE

DIMENSIONS OF JIBS, MAINSAILS, &c, &c,

RELATIVE TO EVERY CLASS OF VESSELS.

DIMENSIONS OF STANDING JIBS.

No.	120 Tons. 8 Cloths.		150 Tons. 10 Cloths.		200 Tons. 11 Cloths.	
	Stay-gores.	Foot-gores.	Stay-gores.	Foot-gores.	Stay-gores.	Foot-gores.
	FT. IN.	IN.	FT. IN.	IN.	FT. IN.	IN.
1	8 0 ...	4	9 0 ...	7	10 10 ...	6
2	5 0 ...	5	7 0 ...	8	4 8 ...	7
3	4 10 ...	7	5 0 ...	9	4 3 ...	8
4	4 6 ...	9	4 0 ...	10	3 11 ...	9
5	4 4 ...	12	3 0 ...	12	3 8 ...	10
6	4 4 ...	14	3 0 ...	14	3 7 ...	12
7	4 4 ...	16	3 0 ...	16	3 5 ...	14
8	4 4 ...	20	3 0 ...	18	3 4 ...	16
9	.....		3 0 ...	20	3 3 ...	18
10	.....		3 0 ...	24	3 2 ...	21
11	.....		.....		3 1 ...	24
	Leech, 31ft. 6in.		Leech, 33ft.		Leech, 36ft.	
	Stay, 40ft.		Stay, 45ft. 6in.		Stay, 49ft.	

No.	250 Tons. 12 Cloths.		300 Tons. 13 Cloths.		300 Tons. 14 Cloths.		340 Tons. 15 Cloths.	
	Stay-gores.	Foot-gores.	Stay-gores.	Foot-gores.	Stay-gores.	Foot-gores.	Stay-gores.	Foot-gores.
	FT. IN.	IN.	FT. IN.	IN.	FT. IN.	IN.	FT. IN.	IN.
1	11 0 ...	6	11 0 ...	0	11 6 ...	0	11 6 ...	4
2	6 4 ...	7	6 4 ...	3	5 4 ...	1	5 6 ...	5
3	4 9 ...	9	4 9 ...	5	4 7 ...	2	4 7 ...	6
4	4 6 ...	10	4 6 ...	7	4 3 ...	3	4 3 ...	7
5	4 3 ...	12	4 3 ...	8	4 0 ...	4	4 0 ...	8
6	4 3 ...	13	4 3 ...	9	3 10 ...	5	3 10 ...	9
7	4 0 ...	14	4 0 ...	11	3 8 ...	7	3 8 ...	10
8	4 0 ...	16	4 0 ...	12	3 6 ...	9	3 6 ...	11
9	3 9 ...	18	3 9 ...	14	3 5 ...	11	3 5 ...	12
10	3 9 ...	20	3 9 ...	16	3 4 ...	13	3 4 ...	13
11	3 6 ...	22	3 6 ...	18	3 4 ...	15	3 4 ...	15
12	3 0 ...	24	3 3 ...	20	3 3 ...	18	3 3 ...	17
13	.....		3 0 ...	22	3 3 ...	21	3 3 ...	19
14	.....		.....		3 3 ...	24	3 3 ...	21
15	.....		.....		.....		3 3 ...	24
	Leech, 43ft. 6in.		Leech, 45ft.		Leech, 47ft.		Leech, 48ft.	
	Stay, 57ft.		Stay, 60ft.		Stay, 63ft.		Stay, 67ft. 6in.	

DIMENSIONS OF STANDING JIBS (CONTINUED).

500 Tons. 16 Cloths.			600 Tons. 17 Cloths.			700 Tons. 18 Cloths.			900 Tons. 19 Cloths.			
No	Stay-gores.	Foot-gores.	Stay-gores.	Foot-gores.	Stay-gores.	Foot-gores.	Stay-gores.	Foot-gores.	Stay-gores.	Foot-gores.		
	FT. IN.	IN.	FT. IN.	IN.	FT. IN.	IN.	FT. IN.	IN.	FT. IN.	IN.		
1	11 6	...	3	11 6	...	2	11 0	...	1	11 3	...	2
2	5 6	...	4	5 6	...	3	6 4	...	0	4 10	...	1
3	4 7	...	5	4 7	...	4	4 9	...	1	4 2	...	0
4	4 3	...	6	4 3	...	5	4 9	...	2	3 9	...	1
5	4 0	...	7	4 0	...	6	4 0	...	3	3 4	...	2
6	3 10	...	8	3 10	...	7	4 0	...	4	3 3	...	3
7	3 8	...	9	3 8	...	8	3 6	...	5	3 2	...	4
8	3 6	...	10	3 6	...	9	3 6	...	6	3 1	...	5
9	3 5	...	11	3 5	...	10	3 3	...	7	2 11	...	6
10	3 4	...	12	3 4	...	11	3 3	...	8	2 11	...	7
11	3 4	...	13	3 4	...	12	3 0	...	9	2 10	...	8
12	3 3	...	15	3 3	...	13	3 0	...	11	2 10	...	9
13	3 3	...	17	3 3	...	15	3 0	...	12	2 9	...	11
14	3 3	...	19	3 3	...	17	3 0	...	14	2 9	...	12
15	3 3	...	21	3 3	...	19	3 0	...	16	2 8	...	14
16	3 3	...	24	3 3	...	21	3 0	...	18	2 8	...	16
17	.....			3 3	...	24	3 0	...	21	2 7	...	18
18	.....			.....			3 0	...	24	2 7	...	21
19	.....			.....			.....			2 7	...	24
Leech, 50ft. Stay, 70ft. 6in.			Leech, 54ft. cut Stay, 73ft.			Leech, 59ft. Stay, 75ft.			Leech, 54ft. 6in. Stay, 75ft.			

1,000 Tons. 20 Cloths.			1,300 Tons. 21 Cloths.			1,400 Tons. 22 Cloths.			
No.	Stay-gores.	Foot-gores.	Stay-gores.	Foot-gores.	Stay-gores.	Foot-gores.	Stay-gores.	Foot-gores.	
	FT. IN.	IN.	FT. IN.	IN.	FT. IN.	IN.	FT. IN.	IN.	
1	11 0	...	3	11 0	...	3	11 0	...	4
2	6 4	...	2	6 4	...	2	6 4	...	3
3	4 9	...	0	4 9	...	1	4 9	...	2
4	4 9	...	1	4 9	...	0	4 9	...	1
5	4 0	...	2	4 0	...	1	4 0	...	0
6	4 0	...	3	4 0	...	2	4 0	...	1
7	3 6	...	4	3 6	...	3	3 6	...	1
8	3 6	...	5	3 6	...	4	3 6	...	2
9	3 2	...	6	3 2	...	5	3 2	...	2
10	3 2	...	7	3 2	...	6	3 2	...	3
11	3 0	...	8	3 0	...	7	3 0	...	3
12	3 0	...	9	3 0	...	8	3 0	...	4
13	2 10	...	10	2 10	...	9	2 10	...	4
14	2 10	...	11	2 10	...	10	2 10	...	5
15	2 8	...	13	2 8	...	11	2 8	...	5
16	2 8	...	15	2 8	...	13	2 8	...	6
17	2 6	...	17	2 6	...	15	2 6	...	7
18	2 6	...	19	2 6	...	17	2 6	...	8
19	2 6	...	21	2 6	...	19	2 6	...	9
20	2 6	...	24	2 6	...	21	2 6	...	10
21	.....			2 6	...	24	2 6	...	12
22	.....			.....			2 6	...	14
Leech, 59ft. 3in. Stay, 79ft.			Leech, 61ft. 9in. Stay, 81ft. 6in.			Leech, 70ft. Stay, 87ft.			

DIMENSIONS OF ANGULATED JIBS.

Leech, cut, 19ft. Stay, 25ft. Foot, 12ft. 9in. Seam-gore, 15in. Canvass, 27 yards.			Leech, cut, 23ft. Stay, 29ft. Foot, 8ft. 8in. Seam-gore, 14in. Canvass, 36 yards.			Leech, cut, 31ft. Stay, 44ft. Foot, cut, 18ft. 8in. Seam-gore, 8in. Canvass, 47 yards.		
Leech Stay-gores.	Cloths.	Foot Stay-gores.	Leech Stay-gores.	Cloths.	Foot Stay-gores.	Leech Stay-gores.	Cloths.	Foot Stay-gores.
FT. IN.	NO.	FT. IN.	FT. IN.	NO.	FT. IN.	FT. IN.	NO.	FT. IN.
3 6	1	1 11	3 10	1	2 0	5 10	1	3 3
3 6	2	1 11	3 10	2	2 0	5 10	2	3 3
3 6	3	2 0	3 11	3	2 0	5 10	3	3 3
3 9	4	2 2	3 11	4	2 0	5 10	4	3 3
.....	...	.....	2 0	$\frac{1}{2}$	1 0	5 0	$\frac{3}{4}$	2 6
.....
14 3	4	8 0	17 6	4 $\frac{1}{2}$	9 0	28 4	4 $\frac{1}{2}$	15 6
Leech, cut, 37ft. Stay, 51ft. Foot, cut, 19ft. Seam-gore, 7in. Canvass, 72 yards.			Leech, 32ft. Stay, 46ft. 6in. Foot, 20ft. 6in. Seam-gore, 12in. Canvass, 54 $\frac{1}{2}$ yards.			Leech, cut, 33 $\frac{1}{2}$ ft. Stay, 48ft. 6in. Foot, 23ft. Seam-gore, 11in. Canvass, 63 yards.		
Leech Stay-gores.	Cloths.	Foot Stay-gores.	Leech Stay-gores.	Cloths.	Foot Stay-gores.	Leech Stay-gores.	Cloths.	Foot Stay-gores.
FT. IN.	NO.	FT. IN.	FT. IN.	NO.	FT. IN.	FT. IN.	NO.	FT. IN.
6 10	1	3 2	4 9	1	2 8	5 3	1	3 2
6 10	2	3 2	4 9	2	2 8	5 3	2	3 2
7 0	3	3 4	4 9	3	2 8	5 3	3	3 3
7 2	4	3 4	4 9	4	2 10	5 3	4	3 3
7 2	5	3 4	5 0	5	2 10	5 3	5	3 3
.....	...	.....	2 6	$\frac{1}{2}$	1 6	3 6	$\frac{3}{4}$	2 3
35 0	5	16 4	26 6	5 $\frac{1}{2}$	15 2	29 9	5 $\frac{3}{4}$	18 4

DIMENSIONS OF ANGULATED JIBS.

Leech, cut, 32½ft. Stay, 45½ft. Foot, cut, 21ft. Seam-gore, 10in. Canvass, 61 yards.			Leech, cut, 26ft. Stay, 41ft. 6in. Foot, 22ft. 6in. Seam-gore, 10½in. Canvass, 60 yards.			Leech, cut, 34ft. Stay, 47ft. Foot, cut, 21½ft. Seam-gore, 10½in. Canvass, 67 yards.		
Leech Stay-gores.	Cloths.	Foot Stay-gores.	Leech Stay-gores.	Cloths.	Foot Stay-gores.	Leech Stay-gores.	Cloths.	Foot Stay-gores.
FT. IN.	NO.	FT. IN.	FT. IN.	NO.	FT. IN.	FT. IN.	NO.	FT. IN.
5 0	1	2 10	3 6	1	2 9	4 8	1	2 7
5 0	2	2 10	3 6	2	2 9	4 8	2	2 7
5 0	3	2 10	3 6	3	2 9	4 9	3	2 8
5 0	4	2 10	3 6	4	2 9	4 9	4	2 8
5 0	5	2 10	3 6	5	2 9	5 0	5	2 10
3 9	6	2 1½	3 6	6	2 9	5 0	6	2 10
28 9	5½	16 3½	21 0	5½	16 6	28 10	6	16 2
Leech, cut, 31ft. Stay, 43ft. 6in. Foot, cut, 24ft. Seam-gore, 13in. Canvass, 66½ yards.			Leech, cut, 28ft. Stay, 40ft. Foot, 20ft. 4in. Seam-gores, 12in. Canvass, 56 yards.			Leech, cut, 32ft. Stay, 46ft. Foot, 21ft. 9in. Seam-gore, 14in. Canvass, 65 yards.		
Leech Stay-gores.	Cloths.	Foot Stay-gores.	Leech Stay-gores.	Cloths.	Foot Stay-gores.	Leech Stay-gores.	Cloths.	Foot Stay-gores.
FT. IN.	NO.	FT. IN.	FT. IN.	NO.	FT. IN.	FT. IN.	NO.	FT. IN.
4 0	1	2 10	3 8	1	2 4	4 0	1	2 5
4 0	2	2 10	3 8	2	2 4	4 0	2	2 5
4 0	3	2 10	3 8	3	2 4	4 0	3	2 5
4 0	4	2 10	3 8	4	2 4	4 0	4	2 5
4 0	5	2 10	3 8	5	2 4	4 0	5	2 5
4 0	6	2 10	3 8	6	2 4	4 0	6	2 5
24 0	6	17 0	22 0	6	14 0	24 0	6	14 6

DIMENSIONS OF ANGULATED JIBS.

Leech, cut, 37½ft. Stay, 51ft. Foot, 21ft. 6in. Seam-gore, 12in. Canvass, 68 yards.			Leech, cut, 34½ft. Stay, 45ft. 6in. Foot, 21ft. 3in. Seam-gore, 13½in. Canvass, 66½ yards.			Leech, cut, 32ft. Stay, 46ft. 4in. Foot, 16ft. 6in. Seam-gore, 12in. Canvass, 69½ yards.		
Leech Stay-gores.	Cloth.	Foot Stay-gores.	Leech Stay-gores.	Cloth.	Foot Stay-gores.	Leech Stay-gores.	Cloth.	Foot Stay-gores.
FT. IN.	NO.	FT. IN.	FT. IN.	NO.	FT. IN.	FT. IN.	NO.	FT. IN.
5 0	1	2 5	4 3	1	2 2	3 10	1	2 6
5 0	2	2 5	4 3	2	2 2	3 10	2	2 6
5 0	3	2 5	4 3	3	2 2	4 0	3	2 6
5 0	4	2 5	4 3	4	2 2	4 0	4	2 6
5 0	5	2 5	4 3	5	2 3	4 2	5	2 8
5 0	6	2 5	4 6	6	2 3	4 2	6	2 8
2 0	½	0 9	2 6	½	1 2	2 3	½	1 5
32 0	6½	15 3	28 3	6½	14 4	26 3	6½	16 9
Leech, cut, 34ft. Stay, 46ft. 8in. Foot, cut, 22ft. Seam-gore, 13in. Canvass, 68½ yards.			Leech, cut, 36ft. Stay, 55ft. Foot, cut, 25ft. Seam-gore, 11in. Canvass, 83½ yards.			Leech, cut, 34½ft. Stay, 52ft. Foot, 19ft. Seam-gore, 13in. Canvass, 81 yards.		
Leech Stay-gores.	Cloth.	Foot Stay-gores.	Leech Stay-gores.	Cloth.	Foot Stay-gores.	Leech Stay-gores.	Cloth.	Foot Stay-gores.
FT. IN.	NO.	FT. IN.	FT. IN.	NO.	FT. IN.	FT. IN.	NO.	FT. IN.
4 4	1	2 4	4 3	1	2 7	3 11	1	2 9
4 4	2	2 4	4 3	2	2 7	3 11	2	2 9
4 4	3	2 4	4 3	3	2 7	3 11	3	2 9
4 4	4	2 4	4 3	4	2 7	3 11	4	2 9
4 4	5	2 4	4 3	5	2 9	3 11	5	2 9
4 4	6	2 4	4 4	6	2 9	3 11	6	2 9
2 4	½	1 4	4 6	7	2 9	4 0	7	2 10
28 4	6½	15 4	30 1	7	18 7	27 6	7	19 4

DIMENSIONS OF ANGULATED JIBS.

Leech, cut, 30ft. 3in. Stay, 45ft. 9in. Foot, 23ft. 9in. Seam-gore, 14in. Canvass, 72½ yards.			Leech, cut, 38ft. Stay, 54ft. Foot, cut, 27½ft. Seam-gore, 12½in. Canvass, 94 yards.			Leech, cut, 39ft. Stay, 56ft. Foot, 28ft. Seam-gore, 13½in. Canvass, 94½ yards.		
Leech Stay-gores.	Cloths.	Foot Stay-gores.	Leech Stay-gores.	Cloths.	Foot Stay-gores.	Leech Stay-gores.	Cloths.	Foot Stay-gores.
FT. IN.	NO.	FT. IN.	FT. IN.	NO.	FT. IN.	FT. IN.	NO.	FT. IN.
3 0	1	2 4	3 10	1	2 6	4 0	1	2 6
3 2	2	3 0	3 10	2	2 6	4 0	2	2 6
3 3	3	3 0	3 10	3	2 6	4 0	3	2 6
3 3	4	2 10	4 0	4	2 8	4 0	4	2 6
3 3	5	2 4	4 0	5	2 8	4 2	5	2 7
3 5	6	2 0	4 2	6	2 10	4 4	6	2 9
2 9	7	1 9	4 2	7	2 10	4 6	7	2 11
.....	...	... ..	2 2	½	1 6	2 4	½	1 5
.....
22 1	7	17 3	30 0	7½	20 0	31 4	7½	19 8

Leech, 36ft. Stay, 56ft. Foot, 26ft. 6in. Seam-gore, 12½in. Canvass, 102½ yards.			Leech, 30ft. Stay, 55ft. Foot, 23ft. 3in. Seam-gore, 12in. Canvass, 96½ yards.			Leech, cut, 45ft. 6in. Stay, 84ft. Foot, 30ft. Seam-gore, 10½in. Canvass, 123 yards.		
Leech Stay-gores.	Cloths.	Foot Stay-gores.	Leech Stay-gores.	Cloths.	Foot Stay-gores.	Leech Stay-gores.	Cloths.	Foot Stay-gores.
FT. IN.	NO.	FT. IN.	FT. IN.	NO.	FT. IN.	FT. IN.	NO.	FT. IN.
3 6	1	1 8	3 2	1	1 10	4 3	1	2 6
3 6	2	2 2	3 9	2	1 10	4 3	2	2 6
3 6	3	2 2	3 9	3	1 10	4 3	3	2 6
3 6	4	2 2	4 1	4	1 10	4 3	4	2 6
4 0	5	2 6	4 3	5	2 0	4 6	5	2 8
4 0	6	3 0	4 3	6	2 0	4 6	6	2 8
4 0	7	3 0	4 9	7	2 4	4 9	7	2 10
3 0	8	2 0	4 9	8	2 4	4 9	8	2 10
.....	...	.....	.....	...	.....	2 6	½	1 6
29 0	7½	18 8	33 4	8	16 0	38 0	8½	22 6

DIMENSIONS OF JIBS ON A. TAYLOR'S PLAN.

(SEE PAGE 95).

Leech, 21ft. 6in., tabled. Stay, 31ft. 6in., 10 cloths. Foot, 15ft., eq. to 8 cloths.			Leech, 20ft. 3in. tabled. Stay, 38ft. 3in., 14 clo's. Foot, 21ft. 9in. 11 clo's.			Leech, 26ft. 6in. tabled. Stay, 47ft., 18 cloths. Foot, 25ft., 12 cloths.		
No.	Stay- gores. FT. IN.	Foot- gores. IN.	No.	Stay- gores. FT. IN.	Foot- gores. IN.	No.	Stay- gores. FT. IN.	Foot- gores. IN.
1	3 6 ...	3	2	6 ...	2	2	6 ...	2
2	3 0 ...	1	2	3 ...	3	2	3 ...	3
3	2 10 ...	0	2	3 ...	4	2	3 ...	4
4	2 10 ...	1	2	2 ...	5	2	2 ...	5
5	2 9 ...	3	2	2 ...	7	2	2 ...	7
6	2 9 ...	6	2	1 ...	9	2	1 ...	9
7	2 8 ...	10	2	1 ...	11	2	1 ...	11
8	2 8 ...	16	2	0 ...	13	2	0 ...	13
9	2 7 ...	12 9	2	0 ...	15	2	0 ...	15
10	2 4 ...	12 9	2	0 ...	18	2	0 ...	18
11	.....		2	0 ...	21	2	0 ...	21
12	.....		2	0 ...	6 6	1	10 ...	24
13	.....		2	0 ...	6 6	1	10 ...	4 0
14	.....		2	0 ...	6 6	1	10 ...	4 0
15	.....		.....	.....	.....	1	10 ...	4 0
16	.....		.....	.....	.....	1	10 ...	4 0
17	.....		.....	.....	.....	1	10 ...	4 0
18	.....		.....	.....	.....	1	10 ...	4 0

Leech, 28ft. 6in. tabled. Stay, 50ft., 19 cloths. Foot, 24ft. 6in., 12 cloths.			Leech, 34ft. 6in. Stay, 49ft. 6in. Foot, 23ft.			Stay, 13 cloths. Foot, 10 cloths.		
No.	Stay- gores. FT. IN.	Foot- gores. IN.	No.	Stay- gores. FT. IN.	Foot- gores. IN.	No.	Stay- gores. FT. IN.	Foot- gores. IN.
1	3 0 ...	2	4	3 ...	1	3	9 ...	0
2	2 6 ...	3	3	6 ...	0	3	3 ...	1
3	2 3 ...	4	3	2 ...	1	3	0 ...	2
4	2 3 ...	5	3	0 ...	2	2	11 ...	3
5	2 2 ...	7	2	11 ...	3	2	10 ...	4
6	2 2 ...	9	2	11 ...	4	2	10 ...	5
7	2 1 ...	11	2	10 ...	5	2	9 ...	7
8	2 1 ...	13	2	10 ...	6	2	9 ...	9
9	2 0 ...	15	2	9 ...	7	2	8 ...	12
10	2 0 ...	18	2	9 ...	9	2	8 ...	16
11	2 0 ...	21	2	8 ...	12	2	7 ...	10 6
12	2 0 ...	24	2	8 ...	16	2	7 ...	10 6
13	1 10 ...	4 0	2	7 ...	15 0	2	5 ...	10 6
14	1 10 ...	4 0	2	7 ...	15 0			
15	1 10 ...	4 0	2	5 ...	15 0			
16	1 10 ...	4 0	NOTE.—The leech- gore overshoots at the foot half a cloth at the clue.					
17	1 10 ...	4 0						
18	1 10 ...	4 0						
19	1 10 ...	4 0						

DIMENSIONS OF JIBS, WITH LONG TACK-CLOTHS.

Leech, 40ft. cut. Stay, 53ft. Foot, 9 cloths. Canvass, 85½yds.				Leech, 37½ft. ot. Stay, 51ft. Foot, 10 cloths. Canvass, 92½yds.				Leech, 38ft. 6in. Stay, 64ft. Foot, 11 cloths. Can's, 102½ yds.				Leech, 45ft. cut. Stay, 62ft. Foot, 29ft. 6in. Can's, 139½yds.			
No.	Stay-gores.		Foot-gores.	No.	Stay-gores.		Foot-gores.	No.	Stay-gores.		Foot-gores.	No.	Stay-gores.		Foot-gores.
	FT.	IN.	IN.		FT.	IN.	IN.		FT.	IN.	IN.		FT.	IN.	IN.
1	4	9	... 36	4	0	...	45	3	6	...	42	3	10	...	54
2	4	9	... 30	4	0	...	32	3	6	...	33	3	10	...	45
3	4	9	... 25	4	0	...	24	3	6	...	26	3	10	...	36
4	4	9	... 20	4	0	...	18	3	6	...	20	3	10	...	28
5	4	9	... 16	4	0	...	14	3	6	...	15	3	10	...	21
6	5	0	... 12	4	0	...	10	3	6	...	11	3	10	...	16
7	5	0	... 10	4	0	...	7	3	6	...	7	3	10	...	12
8	5	0	... 8	4	0	...	5	3	6	...	5	3	10	...	9
9	14	6	... 6	4	0	...	4	3	6	...	4	3	10	...	7
10	.....			14	0	...	3	14	6	...	3	4	10	...	5
11	.....			.....				15	6	...	2	21	0	...	3

Leech, 40ft. cut. Stay, 57½ft. Foot, 12 cloths. Canvass, 114yds.				Leech, 40ft. Stay, 58ft. Foot, 10 cloths. Canv's, 106yds.				Leech, 23½ft. cut Stay, 32ft. Foot, 7 cloths. Canvass, 38½yds.				Leech, 32½ft cut Stay, 43 feet. Foot, 8 cloths. Canvass, 60yds.					
No.	Stay-gores.		Foot-gores.	No.	Stay-gores.		Foot-gores.	No.	Stay-gores.		Foot-gores.	No.	Stay-gores.		Foot-gores.		
	FT.	IN.	IN.		FT.	IN.	IN.		FT.	IN.	IN.		FT.	IN.	IN.		
1	3	4	... 36	4	4	...	48	3	6	...	30	4	3	...	27		
2	3	4	... 30	4	4	...	40	3	6	...	24	4	3	...	24		
3	3	4	... 25	4	4	...	33	3	6	...	18	4	3	...	21		
4	3	4	... 21	4	4	...	26	3	6	...	14	4	3	..	18		
5	3	4	... 18	4	4	...	20	3	6	...	10	4	4	...	16		
6	3	4	... 15	4	4	...	15	3	6	...	7	4	4	...	14		
7	3	4	... 12	4	4	...	12	10	6	...	5	4	4	...	13		
8	3	4	... 10	4	4	...	9	.....				13	0	...	10	
9	3	4	... 8	4	4	...	6										
10	3	4	... 6	19	0	...	4										
11	3	4	... 5														
12	17	0	... 4														

DIMENSIONS OF MAINSAILS.

Head, 11 cloths. Foot, 17½ cloths. Mast, 27ft. 6in., cut. Leech, 40ft. 2in., cut. No. 1, 188½ yards.				Head, 13 cloths. Foot, 18 cloths. Mast, 27ft. 6in., cut. Leech, 42 feet, cut. No. 1, 184½ yards.				Head, 12 cloths. Foot, 19 cloths. Mast, 32 feet, cut. Leech, 45ft. 8in., cut. No. 1, 230½ yards.			
Cloths	Foot Gores.	Mast Gores.	Slack Seams.	Cloths	Foot Gores.	Mast Gores.	Slack Seams.	Cloths	Foot Gores.	Mast Gores.	Slack Seams.
1	12	1	10½	1	12	1	10½	1	12	1	10½
2	17	3	9	2	17	3	9	2	18	4	3
3	14	3	9	3	15	5	1½	3	18	4	3
4	12	3	9	4	12	5	1½	4	16	4	3
5	10	3	9	5	9	5	1½	5	14	4	3
6	8	3	9	6	7	5	1½	6	12	4	3
7	6	3	9	7	5	5	1½	7	10	4	3
8	5	3	9	8	4	5	1½	8	8	3	3
9	4	3	9	9	3	5	1½	9	6	3	3
10	3	3	9	10	2	5	1½	10	5	3	3
11	2	3	9	11	1	5	1½	11	4	3	3
12	2	3	9	12	0	5	1½	12	3	3	3
13	1	3	9	13	0	5	1½	13	2	3	3
14	0	3	9	14	0	5	1½	14	1	3	3
15	0	3	9	15	0	5	1½	15	0	3	3
16	1	3	9	16	1	5	1½	16	1	3	3
17	2	3	9	17	1	5	1½	17	2	3	3
18	2	3	9	18	2	5	1½	18	2	3	3
19	2	3	9	19	2	5	1½	19	3	3	3
Head, 11½ cloths. Foot, 16 cloths. Mast, 32 feet, cut. Leech, 43 feet, cut. No. 2, 186 yards.				Head, 11 cloths. Foot, 17 cloths. Mast, 26 feet, cut. Leech, 39ft. 6in., cut. No. 1, 191 yards.				Head, 11½ cloths. Foot, 17 cloths. Mast, 29 feet, cut. Leech, 40ft. 6in., cut. No. 1, 196½ yards.			
Cloths	Foot Gores.	Mast Gores.	Slack Seams.	Cloths	Foot Gores.	Mast Gores.	Slack Seams.	Cloths	Foot Gores.	Mast Gores.	Slack Seams.
1	12	7	1½	1	21	3	10	1	20	4	7
2	9	7	1½	2	18	3	10	2	18	4	7
3	6	7	1½	3	16	3	10	3	16	4	7
4	5	7	1½	4	14	3	10	4	14	4	7
5	4	7	1½	5	12	3	10	5	12	4	7
6	3	7	1½	6	10	3	10	6	10	3	5½
7	2	7	1½	7	8	3	10	7	8	3	5½
8	1	7	1½	8	7	3	10	8	6	3	5½
9	0	7	1½	9	6	3	10	9	4	3	5½
10	0	7	1½	10	5	3	10	10	3	3	5½
11	0	7	1½	11	4	3	10	11	2	3	5½
12	0	7	1½	12	3	3	10	12	1	3	5½
13	0	7	1½	13	2	3	10	13	0	3	5½
14	1	7	1½	14	1	3	10	14	1	3	5½
15	2	7	1½	15	0	3	10	15	2	3	5½
16	3	7	1½	16	0	3	10	16	2	3	5½
17	3	7	1½	17	0	3	10	17	3	3	5½

DIMENSIONS OF SPANKERS.

Head, 8½ cloths. Foot, 12 cloths. Mast, cut, 22ft. Leech, cut, 28ft. 6in. No. 4, 90½ yards.			Head, 8 cloths. Foot, 12½ cloths. Mast, cut, 22ft. Leech, cut, 32½ft. No. 4, 102 yards.			Head, 10 cloths. Foot, 13 cloths. Mast, cut, 19½ft. Leech, cut, 31½ft. No. 3, 113 yards.		
No.	Foot-gores. IN.	Mast-gores. FT. IN.	Foot-gores. IN.	Mast-gores. FT. IN.	Foot-gores. IN.	Mast-gores. FT. IN.	Slack-seam. IN.	
1	...	...	12	...	2	3	
2	6	5 11	19	...	4	6	18 ... 6 2 ...	
3	5	5 11	15	...	4	6	15 ... 6 2 ...	
4	5	5 11	12	...	4	6	12 ... 6 2 ...	
5	5	2 11½	9	...	4	6	9 ...	
6	4	Head-gore, cut, 5in. per cloth.	7	...	Head-gore, cut, 6in. per cloth.	...	7 ...	
7	4		5	...		5 ...		
8	4		4	...		4 ...		
9	4		3	...		3 ...		
10	3		2	...		2 ...		
11	3		1	...		1 ...		
12	3		0	...		0 ...		
13	3		0	...		1 ...		
	...	...	...	...	2	...	...

Head, 10 cloths. Foot, 15 cloths. Mast, cut, 26ft. Leech, cut, 39ft. No. 3, 144½ yards.			Head, 11 cloths. Foot, 15 cloths. Mast, cut, 23ft. Leech, cut, 36½ft. No. 3, 145½ yards.			Head, 10 cloths. Foot, 14 cloths. Mast, cut, 22ft. Leech, cut, 32ft. No. 4, 114½ yards.		
No.	Foot-gores. IN.	Mast-gores. FT. IN.	Foot-gores. IN.	Mast-gores. FT. IN.	Slack-seam. IN.	Foot-gores. IN.	Mast-gores. FT. IN.	
1	12	5 1	24	5 5	...	19	4 10	
2	10	5 1	21	5 5	...	16	4 10	
3	8	5 1	18	5 5	...	14	4 10	
4	6	5 1	15	5 5	...	12	4 10	
5	4	5 1	12	...	...	10	...
6	3	Head-gore, cut, 13in. per cloth.	9	...	...	8	...
7	2		7	...	1	6	...	
8	1		5	...	1	5	...	
9	1		3	...	1	4	...	
10	0		2	...	2	3	...	
11	0		1	...	2	2	...	
12	0		0	...	3	1	...	
13	1		0	...	3	0	...	
14	2	...	1	...	3	0	...	
15	3	...	2	...	4	0	...	

DIMENSIONS OF SPANKERS.

Head, 11 cloths. Foot, 16 cloths. Mast, 21ft., tabled. Leech, 37½ft. No. 3., 134½ yards.				Head, 12 cloths. Foot, 16 cloths. Mast, 17ft. 4in. Leech, 30ft. No. 3, 120 yards.				Head, 12 cloths. Foot, 15½ cloths. Mast, 23ft., cut. Leech, 36ft. No. 3, 148 yards.			
Cloths.	Foot-gores.	Mast-gores.	Slack-seams.	Cloths.	Foot-gores.	Mast-gores.	Slack-seams.	Cloths.	Foot-gores.	Mast-gores.	Slack-seams.
	IN.	FT. IN.	IN.		IN.	FT. IN.	IN.		IN.	FT. IN.	IN.
1	16	5 0	...	1	21	3 10	...	1	12	.....	3 1
2	14	4 0	...	2	19	3 10	...	2	19	.....	6 2
3	13	4 0	...	3	17	3 10	...	3	16	.....	6 2
4	12	4 0	...	4	15	3 10	...	4	13	.....	6 2
5	10	3 0	...	5	13	.....	...	5	10	.....	.....
6	9	.....	...	6	11	Head-gore, cut,	.....	6	8	.....	.....
7	8	Head-gore, cut,	.....	7	9	per cloth.	.....	7	6	Head-gore, cut,	.....
8	6	per cloth.	.....	8	7	.....	.....	8	5	8in. per cloth.	.....
9	4	.....	.....	9	6	.....	1	9	4	.....	.....
10	3	.....	2	10	5	.....	1	10	3	.....	.....
11	2	Head-gore, cut,	3	11	4	Head-gore, cut,	2	11	2	.....	.....
12	1	4in. per cloth.	4	12	3	3in. per cloth.	2	12	1	.....	.....
13	0	.....	5	13	2	.....	3	13	0	.....	.....
14	1	.....	6	14	1	.....	3	14	1	.....	.....
15	2	.....	7	15	0	.....	4	15	2	.....	.....
16	3	.....	8	16	0	.....	4	16	3	.....	.....

Head, 12 cloths. Foot, 17 cloths. Mast, cut, 21½ft. Leech, cut, 38½ft. No. 3, 159½ yards.				Head, 13 cloths. Foot, 17½ cloths. Mast, 24ft. Leech, 42ft. No. 3, 175½ yards.				Head, 13 cloths. Foot, 18 cloths. Mast, 26ft. Leech, 44ft. No. 3, 210½ yards.			
Cloths.	Foot-gores.	Mast-gores.	Slack-seams.	Cloths.	Foot-gores.	Mast-gores.	Slack-seams.	Cloths.	Foot-gores.	Mast-gores.	Slack-seams.
	IN.	FT. IN.	IN.		IN.	FT. IN.	IN.		IN.	FT. IN.	IN.
1	28	4 1	...	1	7	3 0	...	1	15	5 6	...
2	24	4 1	...	2	12	6 0	...	2	14	5 6	...
3	20	4 1	...	3	11	6 0	...	3	13	5 2	...
4	17	4 1	...	4	10	5 6	...	4	12	5 2	...
5	14	3 4	...	5	9	5 6	...	5	11	4 8	...
6	11	.....	...	6	8	.....	...	6	10	.....	...
7	9	Head-gore, cut,	.....	7	7	Head-gore, cut,	.....	7	9	Head-gore, cut,	.....
8	7	per cloth.	.....	8	6	per cloth.	.....	8	8	per cloth.	.....
9	5	.....	...	9	5	.....	...	9	7	.....	...
10	4	.....	1	10	4	.....	1	10	6	.....	1
11	3	Head-gore, cut,	1	11	3	Head-gore, cut,	2	11	5	Head-gore, cut,	1
12	2	7in. per cloth.	1	12	2	8in. per cloth.	3	12	4	per cloth.	2
13	1	.....	2	13	1	.....	4	13	3	.....	3
14	0	.....	2	14	0	.....	5	14	2	.....	4
15	1	.....	2	15	1	.....	6	15	1	.....	5
16	2	.....	3	16	2	.....	7	16	0	.....	6
17	3	.....	3	17	3	.....	8	17	2	.....	7
18	.....	.....	.....	18	.....	.....	.....	18	3	.....	7

DIMENSIONS OF MAIN SPENCERS.

Head, 13 cloths. Foot, 18 cloths. Mast, 27ft. cut. Leech, 42ft. 6in. cut. No. 3, 197 yards.				Head, 12 cloths. Foot, 18 cloths. Mast, 23ft. cut. Leech, 36ft. 6in. cut. No. 1, 168½ yards.				Head, 12½ cloths. Foot, 17 cloths. Mast, 21ft. cut. Leech, 34ft. cut. No. 2, 135½ yards.			
Cloths.	Foot-gores. IN.	Mast-gores. FT. IN.	Slack-seams. IN.	Cloths.	Foot-gores. IN.	Mast-gores. FT. IN.	Slack-seams. IN.	Cloths.	Foot-gores. IN.	Mast-gores. FT. IN.	Slack-seams. IN.
1	18	5 1	.. ..	24	.. 3 3	.. ..	.. ..	10	.. 4 2	.. ..	.. ..
2	16	.. 5 1	.. ..	22	.. 3 3	.. ..	.. ..	9	.. 4 2	.. ..	.. ..
3	14	.. 5 1	.. ..	20	.. 3 3	.. ..	.. ..	9	.. 4 2	.. ..	.. ..
4	12	.. 5 1	.. ..	18	.. 3 3	.. ..	.. ..	8	.. 4 2	.. ..	.. ..
5	10	.. 5 1	.. ..	16	.. 3 3	.. ..	.. ..	8	.. 2 1	.. ..	.. ..
6	8	.. ..	.. ..	14	.. 3 3	.. ..	.. ..	8	.. ..	.. ..	.. ..
7	6	.. ..	.. ..	12	.. ..	.. ..	.. ..	8	.. ..	.. ..	.. ..
8	5	Head-gore, 9in.	.. ..	10	Head-gore, cut,	.. ..	.. ..	7	Head-gore, 5in.	.. ..	.. ..
9	4	.. ..	.. ..	9	.. ..	.. ..	.. ..	7	.. ..	.. ..	.. ..
10	3	.. ..	1	8	.. ..	.. ..	1	7	.. ..	.. ..	1
11	2	Head-gore, 9in.	.. ..	7	.. ..	.. ..	1	7	.. ..	.. ..	1
12	1	.. ..	2	6	Head-gore, 3in.	.. ..	1	6	Head-gore, 3in.	.. ..	1
13	0	.. ..	2	5	.. ..	.. ..	1	6	.. ..	.. ..	1
14	..	.. ..	2	4	.. ..	.. ..	2	6	.. ..	.. ..	2
15	1	.. ..	3	3	.. ..	.. ..	2	5	.. ..	.. ..	2
16	2	.. ..	3	2	.. ..	.. ..	2	5	.. ..	.. ..	3
17	2	.. ..	4	1	.. ..	.. ..	3	5	.. ..	.. ..	3
18	3	.. ..	4½	0	.. ..	.. ..	3	.....	.....	.....	.....
Head, 8 cloths. Foot, 11 cloths. Mast, 20ft. 6in. cut. Leech, 28ft. 8in. cut. No. 2, 90½ yards.				Head, 6 cloths. Foot, 10½ cloths. Mast, 20ft. cut. Leech, 34ft. 9in. No. 1, 84½ yards.				Head, 5 cloths. Foot, 10 cloths. Mast, 23ft. cut. Leech, 32ft. 6in. cut. No. 2, 79½ yards.			
Cloths.	Foot-gores. IN.	Mast-gores. FT. IN.	Slack-seams. IN.	Cloths.	Foot-gores. IN.	Mast-gores. FT. IN.	Slack-seams. IN.	Cloths.	Foot-gores. IN.	Mast-gores. FT. IN.	Slack-seams. IN.
1	10	.. 6 9	.. ..	8	.. 2 3	.. ..	.. ..	18	.. 4 2	.. ..	.. ..
2	9	.. 6 9	.. ..	15½	.. 4 6	.. ..	.. ..	15	.. 4 2	.. ..	.. ..
3	8	.. 6 9	.. ..	15½	.. 4 6	.. ..	.. ..	12	.. 4 2	.. ..	.. ..
4	7	.. ..	.. ..	15½	.. 4 6	.. ..	.. ..	10	.. 4 2	.. ..	.. ..
5	6	.. ..	.. ..	15½	.. 4 6	.. ..	.. ..	8	.. 4 2	.. ..	.. ..
6	5	.. ..	.. ..	15½	.. ..	.. ..	.. ..	7	.. ..	.. ..	.. ..
7	4	.. ..	1	15½	.. ..	.. ..	.. ..	6	.. ..	.. ..	.. ..
8	3	.. ..	2	15½	.. ..	.. ..	1	5	.. ..	.. ..	1
9	2	Head-gore, 9in.	.. ..	15½	.. ..	.. ..	2	4	Head-gore, 11in.	.. ..	2
10	1	.. ..	3	15½	.. ..	.. ..	3	3	.. ..	.. ..	3
11	0	.. ..	3	.....	.....	.....	.....	.....	.....	.....	.....

DIMENSIONS OF FORE-SPENCERS.

Head, 8 cloths. Foot, 11 cloths. Mast, 15ft., cut. Leech, 25½ft., cut. No. 2, 71½yds.				Head, 8½ cloths. Foot, 12 cloths. Mast, 18ft., cut. Leech, 30½ft., cut. No. 1, 93½yds.				Head, 8½ cloths. Foot, 12 cloths. Mast, 20ft., cut. Leech, 33ft., cut. No. 3, 99½yds.			
Cloths.	Foot-gores. IN.	Mast-gores. FT. IN.	Slack-seams. IN.	Cloths.	Foot-gores. IN.	Mast-gores. FT. IN.	Slack-seams. IN.	Cloths.	Foot-gores. IN.	Mast-gores. FT. IN.	Slack-seams. IN.
1	15	4 7	.. ..	21	4 9	.. ..	.. ..	18	5 4	.. ..	.. ..
2	14	4 7	.. ..	18	4 9	.. ..	.. ..	14	5 4	.. ..	.. ..
3	13	4 7	.. ..	16	4 9	.. ..	.. ..	12	5 4	.. ..	.. ..
4	12	4 7	.. ..	14	2 5	.. ..	.. ..	10	2 8	.. ..	.. ..
5	12	4 7	.. ..	12	2 5	.. ..	.. ..	8	2 8	.. ..	.. ..
6	12	4 7	.. ..	10	2 5	.. ..	.. ..	6	2 8	.. ..	.. ..
7	11	4 7	.. ..	8	2 5	.. ..	.. ..	5	2 8	.. ..	.. ..
8	11	4 7	.. ..	7	2 5	.. ..	.. ..	4	2 8	.. ..	.. ..
9	10	4 7	.. ..	6	2 5	.. ..	.. ..	3	2 8	.. ..	.. ..
10	9	4 7	.. ..	5	2 5	.. ..	.. ..	2	2 8	.. ..	.. ..
11	9	4 7	.. ..	4	2 5	.. ..	.. ..	1	2 8	.. ..	.. ..
12	9	4 7	.. ..	3	2 5	.. ..	.. ..	0	2 8	.. ..	.. ..

Head, 8 cloths. Foot, 13 cloths. Mast, 18ft., cut. Leech, 35ft., cut. No. 3, 125½yds.				Head, 8 cloths. Foot, 9½ cloths. Mast, 20½ft., cut. Leech, 27½ft., cut. No. 2, 75½yds.				Head, 7½ cloths. Foot, 10 cloths. Mast, 18ft. Leech, 29ft. No. 3, 81yds.			
Cloths.	Foot-gores. IN.	Mast-gores. FT. IN.	Slack-seams. IN.	Cloths.	Foot-gores. IN.	Mast-gores. FT. IN.	Slack-seams. IN.	Cloths.	Foot-gores. IN.	Mast-gores. FT. IN.	Slack-seams. IN.
1	33	3 3	.. ..	6	8 10	.. ..	.. ..	24	7 6	.. ..	.. ..
2	30	3 3	.. ..	8	11 9	.. ..	.. ..	20	7 6	.. ..	.. ..
3	27	3 3	.. ..	6	11 9	.. ..	.. ..	16	3 9	.. ..	.. ..
4	24	3 3	.. ..	5	11 9	.. ..	.. ..	13	3 9	.. ..	.. ..
5	21	3 3	.. ..	3	11 9	.. ..	.. ..	11	3 9	.. ..	.. ..
6	19	3 3	.. ..	2	11 9	.. ..	.. ..	9	3 9	.. ..	.. ..
7	17	3 3	.. ..	1	11 9	.. ..	.. ..	7	3 9	.. ..	.. ..
8	15	3 3	.. ..	1	11 9	.. ..	.. ..	6	3 9	.. ..	.. ..
9	13	3 3	.. ..	1	11 9	.. ..	.. ..	5	3 9	.. ..	.. ..
10	11	3 3	.. ..	1	11 9	.. ..	.. ..	4	3 9	.. ..	.. ..
11	9	3 3	.. ..	1	11 9	.. ..	.. ..		3 9	.. ..	.. ..
12	7	3 3	.. ..	1	11 9	.. ..	.. ..		3 9	.. ..	.. ..
13	5	3 3	.. ..	1	11 9	.. ..	.. ..		3 9	.. ..	.. ..

DIMENSIONS OF STAY-SAILS.

Leech, 25½ft. Stay, 7 cloths. No. 1, 32½yds.				Leech, 27½ft. Stay, 8 cloths. No. 1, 43½yds.				Leech, 28ft. Stay, 34ft. No. 1, 55yds.				Leech, 30ft. Stay, 32½ft. No. 1, 61yds.				
No.	Foot-gores.		Stay-gores.	Foot-gores.		Stay-gores.	Foot-gores.		Stay-gores.	Foot-gores.		Stay-gores.	Foot-gores.		Stay-gores.	
	IN.	FT. IN.		IN.	FT. IN.		IN.	FT. IN.		IN.	FT. IN.					
1	4	...	3	11	6	...	3	6	3	...	3	0	8	...	2	6
2	2	...	3	9	4	...	3	4	2	...	2	11	7	...	2	6
3	1	...	3	9	2	...	3	4	1	...	2	11	6	...	2	6
4	0	...	3	9	1	...	3	4	0	...	2	11	5	...	2	6
5	2	...	3	8	0	...	3	4	0	...	2	10	4	...	2	6
6	4	...	3	8	2	...	3	4	0	...	2	10	3	...	2	6
7	6	...	3	8	4	...	3	4	0	...	2	10	2	...	2	6
8	.....				6	...	3	4	1	...	2	10	1	...	2	6
9	.....				.....				2	...	2	9	0	...	3	3
10	.....				.....				3	...	2	9	0	...	3	3

SCREW-STEAMER'S STAY-FORESAILS.

Leech, 22ft. Stay, 36½ft. Foot, 23ft. No. 3, 56½yds.			Leech, 25½ft. Stay, 40½ft. Foot, 26½ft. No. 3, 70½yds.			Leech, 23½ft. Stay, 45ft. Foot, 30ft. No. 1, 76½yds.			Leech, 31ft., out. Stay, 46½ft. Foot, 30ft. No. 1, 88½yds.		
No.	Foot-gores.	Stay-gores.	Foot-gores.	Stay-gores.	Foot-gores.	Stay-gores.	Foot-gores.	Stay-gores.	Foot-gores.	Stay-gores.	
	IN.	FT. IN.		IN.		FT. IN.		IN.		FT. IN.	IN.
1	1	2 7	0	... 2 4	2	... 2 8	0	... 2 5			
2	2	2 7	0	... 2 4	3	... 2 8	0	... 2 5			
3	3	2 7	0	... 2 4	4	... 2 7	0	... 2 5			
4	4	2 7	1	... 2 4	5	... 2 7	0	... 2 5			
5	5	2 7	2	... 2 4	6	... 2 6	1	... 2 5			
6	6	2 7	3	... 2 4	7	... 2 6	2	... 2 5			
7	7	2 7	4	... 2 4	8	... 2 5	3	... 2 5			
8	8	2 7	5	... 2 4	9	... 2 5	4	... 2 5			
9	10	2 7	6	... 2 4	10	... 2 4	5	... 2 5			
10	12	2 7	7	... 2 4	11	... 2 4	6	... 2 5			
11	14	2 7	8	... 2 4	12	... 2 3	7	... 2 5			
12	16	2 7	9	... 2 4	13	... 2 3	8	... 2 5			
13	.....		10	... 2 4	14	... 2 2	9	... 2 5		
14	.....		11	... 2 4	15	... 2 2	10	... 2 5		
15	.....		.....		16	... 2 1	11	... 2 5
16	.....		.....		.....		12	... 2 5

DIMENSIONS OF GAFF-TOPSAILS.

Mast, made 36ft. Leech, 30ft., cut. Foot, 10 cloths. No. 5, 74½yds.			Mast, 30ft., cut. Leech, 14½ft., ct. Foot, 13 cloths. No. 5, 87yds.			Mast, made, 41ft. Leech, 33ft., cut. Foot, 11 cloths. No. 6, 73yds.			Mast, 41½ft., cut. Leech, 34½ft. cut. Foot, 10 cloths. No. 5, 71½yds.		
No.	Foot- gores. IN.	Mast- gores. FT. IN.	Foot- gores. IN.	Mast- gores. FT. IN.	Foot- gores. IN.	Mast- gores. FT. IN.	Foot- gores. IN.	Mast- gores. FT. IN.	Foot- gores. IN.	Mast- gores. FT. IN.	
1	0 ...	12 6	4 ...	4 7	0 ...	3 10	2 ...	6 0	2 ...	6 0	
2	0 ...	2 2	3 ...	4 7	0 ...	3 10	1 ...	6 0	1 ...	6 0	
3	0 ...	2 2	2 ...	4 7	1 ...	3 10	1 ...	2 10	1 ...	2 10	
4	0 ...	2 2	1 ...	1 11	1 ...	3 0	0 ...	2 10	0 ...	2 10	
5	1 ...	2 2	0 ...	1 11	2 ...	3 0	0 ...	2 10	0 ...	2 10	
6	2 ...	2 2	0 ...	1 11	2 ...	3 0	1 ...	2 10	1 ...	2 10	
7	3 ...	2 2	1 ...	1 11	3 ...	3 0	2 ...	2 10	2 ...	2 10	
8	5 ...	2 2	2 ...	1 10	4 ...	3 0	3 ...	2 10	3 ...	2 10	
9	7 ...	2 2	3 ...	1 10	6 ...	3 0	4 ...	2 10	4 ...	2 10	
10	10 ...	2 2	5 ...	1 10	9 ...	3 0	6 ...	2 10	6 ...	2 10	
11	.....		7 ...	1 10	13 ...	3 0	.....		.....
12	.....		10 ...	1 10	.....		.....		.....
13	.....		14 ...	1 10	.....		.....		.....

Mast, 43ft. tabled. Leech, 10½yds., cut. Foot, 11 cloths, No. 6, 79½yds.			Leech, 19½ft cut. Foot, 11 cloths. Mast, 28½ft. Head, 1 cloth. No. 5, 51½yds.			Head, 6 cloths. Foot, 13 cloths. Mast, 31½ft. Leech, 23½ft. No. 6, 88yds.			Mast, 48ft. made. Leech, 32f. made Foot, 13 cloths. No. 6, 110½yds.		
No.	Foot- gores. IN.	Mast- gores. FT. IN.	Foot- gores. IN.	Mast- gores. FT. IN.	Foot- gores. IN.	Mast- gores. FT. IN.	Foot- gores. IN.	Mast- gores. FT. IN.	Foot- gores. IN.	Mast- gores. FT. IN.	
1	0 ...	6 0	3 ...	3 0	0 ...	4 10	0 ...	6 0	0 ...	6 0	
2	1 ...	5 0	2 ...	2 6	1 ...	4 10	1 ...	5 0	1 ...	5 0	
3	2 ...	4 0	1 ...	2 6	2 ...	4 6	2 ...	4 0	2 ...	4 0	
4	3 ...	3 6	0 ...	2 3	3 ...	4 6	3 ...	3 6	3 ...	3 6	
5	4 ...	3 3	1 ...	2 3	4 ...	4 2	5 ...	3 3	5 ...	3 3	
6	5 ...	3 0	2 ...	2 0	5 ...	4 2	5 ...	3 0	5 ...	3 0	
7	7 ...	3 0	3 ...	2 0	6 ...	3 10	7 ...	3 0	7 ...	3 0	
8	9 ...	3 0	4 ...	2 0	7 ...	Head	9 ...	3 0	9 ...	3 0	
9	12 ...	2 9	5 ...	2 0	8 ...	Square.	12 ...	2 9	12 ...	2 9	
10	15 ...	2 9	6 ...	2 3	9 ...		15 ...	2 9	15 ...	2 9	
11	18 ...	2 9	7 ...	0 0	10 ...		18 ...	2 9	18 ...	2 9	
12	.....		.....		11 ...		21 ...	2 9	21 ...	2 9
13	.....		.....		12 ...		24 ...	2 9	24 ...	2 9

DIMENSIONS OF A CLIPPER SCHOONER (see page 120).

MASTS, ETC.	Extreme Length.	Headed Length.	YARDS, ETC.	Extreme Length.	Yardarms.
	FT. IN.	FT. IN.		FT. IN.	FT. IN.
Mainmast	69 7	8 3	Fore yard	55 0	2 10
Foremast	66 4	7 10	Topsail yard.....	41 0	2 3
Fore-topmast, hoist	21 0	Royal	Top-gallant yard ...	29 6	1 6
Fore-topgallant mast, hoist	12 0	8 6	Main boom	59 0	Pole
Main-topmast, hoist	35 0		Ditto gaff	29 0	4 0
Bowsprit, outside ...	6 0		Fore gaff/	23 3	
Jib-boom, outside of cap	16 0		Gaff-topsail yard ...	7 0	
Flying jib-boom ...	10 6		Distance from forestay to centre of foremast	29 6	
Lower masts, house each	13 6		From centre of foremast to mainmast	24 0	
Rake of the foremast to the foot ...	0 17 $\frac{1}{2}$		Centre of mainmast to taffrail ...	46 0	
Ditto mainmast	0 2		Height of rail	3 6	
Steave of bowsprit...	0 3 $\frac{1}{2}$				
Rise of the deck.....	1 0				

The above dimensions are given for the young student to go into the sketch given at page 120, and make a drawing of the sails, and calculate the gores for cutting. It will be a good exercise for him. The rule for the foot of the foresail is commonly $\cdot 9$, the distance between the stay and the fore part of the mast; the luff from $\cdot 8$ to $\cdot 87$, the length of the stay, and the leech $\cdot 8$ of the luff. Second Jib.—The length of the foot of the second jib is the distance from the tack to the fore part of the stem, the luff $\cdot 8$ to $\cdot 85$, the length of the stay, and the leech of such a length that the clue may be a proper height for the sheets to bring an equal strain on the foot and leech ropes.

RINGTAIL SAILS.

Although some years have elapsed since sails of this particular kind were made, there are captains of brigs now, who have taken a fancy to have them; and as the younger branch of our sailmakers may know little or nothing about them, we may be excused for giving a description:—

A *Ringtail Sail* sets like a topmast studding sail, outside of the after-leech of main-trysail; it has a sliding gunter-boom, called the ringtail boom, which runs out on the main-trysail boom, for hauling out the sheet. The size of the ringtail sail for a brig is usually 4 or 5 cloths in the head, by 6 or 7 cloths in the foot, and it is made of No. 5 or No. 6 canvass.

DIMENSIONS OF TRIANGULAR LOWER STUDDING SAILS.

350 TONS.			620 TONS.		
Head. 17 cloths.	Foot. 0.	Depth. 8 yards.	Head. 19 cloths.	Foot. 0.	Depth. 10 yards.
	INS.	INS.		INS.	INS.
1	4	11	1	5	13
2	3	11	2	4	13
3	3	11	3	4	14
4	2	11	4	3	14
5	2	12	5	3	15
6	1	12	6	2	15
7	1	13	7	2	16
8	0	13	8	1	16
9	0	14	9	1	17
10	0	15	10	0	17
11	1	16	11	1	18
12	1	18	12	1	19
13	2	20	13	2	20
14	2	22	14	2	21
15	3	24	15	3	22
16	3	27	16	3	23
17	4	38	17	4	24
		12)288	18	4	27
		24 ft.	19	5	36
970 TONS.			900 TONS.		
Head. 24.	Foot. 6.	Depth. 10½ yards.	Head. 24.	Foot. 0.	Depth. 32ft. 6in.
	INS.	INS.		INS.	INS.
1	4		1	4	10
2	3		2	3	10
3	2		3	2	10
4	2		4	2	11
5	2		5	2	11
6	2		6	2	12
7	1	15	7	1	12
8	1	15	8	1	13
9	1	16	9	1	13
10	1	16	10	1	14
11	0	16	11	0	14
12	0	16	12	0	15
13	0	17	13	0	15
14	0	17	14	0	16
15	1	18	15	1	16
16	1	19	16	1	17
17	1	20	17	1	18
18	1	21	18	1	19
19	2	23	19	2	20
20	2	25	20	2	21
21	2	27	21	2	22
22	2	29	22	2	22
23	3	32	23	3	25
24	4	38	24	4	34

APPENDIX.

CUNNINGHAM'S PATENT SELF-REEFING TOPSAILS, FOR REEFING FROM THE DECK WITHOUT SENDING MEN ALOFT.

Every one, who is at all familiar with maritime matters, will be aware of the great danger attending the operation of reefing topsails in heavy weather by the usual mode of men laying-out on the yards, and gathering up and confining the sail thereto by reef-points and earings, and that fearful accidents are of frequent occurrence on such occasions.

Mr. Cunningham's plan of reefing from the deck purposes to mitigate these dangers; and, from the very favourable reports of a large number of intelligent captains, who have tested the system and experienced great benefits from it, there is every reason to believe that Mr. Cunningham has been successful in the accomplishment of the object which he had in view, by his laudable and ingenious invention becoming generally adopted, particularly among the merchant marine.* The sail can be close-reefed in heavy weather by *one man and a boy, in two seconds and a half*—an operation which, under the

* Cunningham's patent is now all the wear. Captains are seeing the utility of it at all times, and merchants are finding the advantage of it, by sending less hands to sea. Although some of our vessels have chafed and worn out a "bonnet" in one voyage of fourteen or fifteen months, yet by a little pains of making a *last* in the sides of the Patent Middle Cloth, when part of the sides get chafed out (for there is plenty of soap used about them), you cut a 12-inches gore in the half breadth, or a right-angle triangle, and *back-stitch* all that part of the tabling which covers the rope, so that the travellers work up and down easily; the back-stitching must be done *well* and *neatly*, and the last being made with a gore, does not lay over on its own part; for if the last is made straight, it will be too thick for the travellers to work over. When the bonnet only is chafed or worn out, shift a new one in its place, and there will be a saving of the cost of bonnet complete, and the labour of sewing the middle cloth into the sail again.

old system, would occupy at least half an hour, and require many men.

A contrivance of such great practical utility deserves and requires a detailed description, which, by the kindness of Mr. Cunningham, the author is enabled to give:—

DESCRIPTION, &c.

The succeeding Figure, No. 2, represents a yard suspended in the bight of the chain-topsail-tie, which chain is received and works in and over a whelped grooved boss, firmly fixed on the yard. This boss is embraced on each side by the sling-hoops, within which it works freely. The sling-hoops are connected together by cross-ties, and are geared to the parrall in the manner which will be no doubt understood by the diagram. A is the hoisting part of the tie, which leads through the sheave-hole at the mast-head in the ordinary manner. B, the fore part of the tie, which is secured to the mast-head by an arrangement of tackles, and which allow of its being released from its security aloft, if required.

The lead of the topsail, ties, &c., are represented as letters. A A and B B are the two parts of the tie, in the bight of which, it will be seen, the topsail-yard hangs. In this drawing, there is a second sheave-hole at the mast-head through which the fore part of the tie is led, a score being cut in the heel of the topgallant mast to allow it to come up clear,* and this plan is the one particularly recommended by the *Patentee*; but other arrangements may be made for the lead of the tie; for instance, two sheave-holes may be put under the cross-trees, a hanging iron-block may also be placed well forward under the heel of the topgallant mast, &c. The end of the tie B is fitted with a runner, the standing part of which is in the top, thus forming double topsail haulyards. The hoisting part A may be fitted with a common purchase on the end, except in large ships, when any arrangement necessary may be made.

In fitting masts on this plan, it is necessary to have a roller put into the score in the heel of the topgallant mast for the chain to work over, which should have an iron band to take pin of roller, and form dogs at foot of score. See Figure 4.

To hoist the whole topsail, both haulyards are hauled on, and when the sail is close up, the part B is belayed; the sail is then ready for reefing. By lowering on the part A, it will be seen that the yard necessarily turns round as it descends the topmast, and the sail is rolled up accordingly. By hoisting on the part A, the yard is par-buckled up, and the sail unrolled.

When reefing, the sail in lowering slacks a little; this is taken up by hauling on the part B, so as to keep the topsail tight set. By

* A roller is also let into the topgallant mast for the chain to lie upon.

lowering on both haulyards, the whole topsail comes down without rolling up.

It is recommended to fit the clue-lines to the lower-mast cap; C shows the clue-line block; and a down-haul tackle, D, is fitted to assist the yard down in case of necessity.

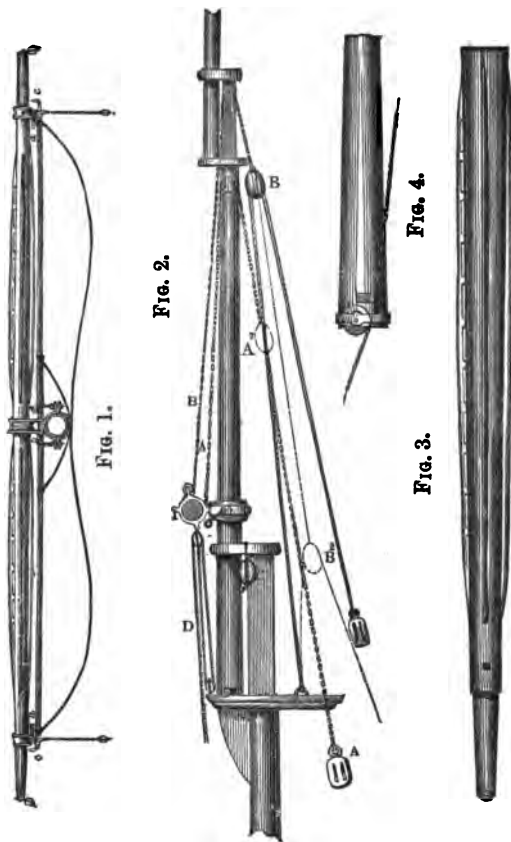


Figure 1, shows a plan of patent topsail-yard fitted complete. The topgallant sheets lead through the iron blocks *a, a*, and down on deck through the quarter-blocks *b, b*. The foot ropes, it will be seen, are attached to the yard-arm irons and chafing spar. The topgallant

studdingsail boom irons are carried on the chafing spar at C C, thus allowing the topsail to be reefed without rigging in the booms should the topgallant studdingsails be set and the ship taken in a squall, which is an important feature.

The annexed diagram represents one of the yard-arm hoops within which the yard works, proper rubbing collars being attached to it. A is a roller shackle to which the topsail-lifts hook, and through which the topgallant sheets are led, and which are continued through a leading block on the tie; B is a spur to which the end of the chafing spar is attached, which is shown on Fig. 1. The

shackles appearing at each end of the hoop are for the braces.

N.B.—The roller shackle, A, is now fixed to the yard-arm ironwork

BONNET, &c.

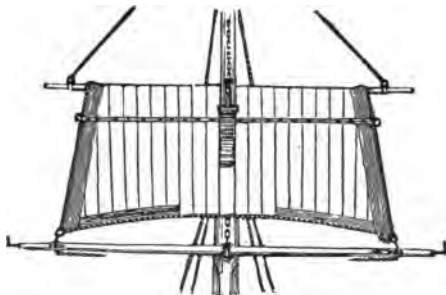
It was necessary to make provision to allow the sail to clear the tie, sling, hoops, &c., and also to prevent the sail from chafing against the lee-rigging when rolled up, and the yard braces forward. The first of them is accomplished by dividing the sail down the centre to some feet below the line of the close reef, the space being sufficiently wide



as to allow the sail to roll up on each side of the fittings on the centre of the yard. The sides of this division are roped in a peculiar way, and travellers of such formation as to embrace the rope, yet allow the sail cloth to pass freely through, work up and down this roping; these travellers are disposed at intervals of about one foot; and are connected together across the division. A cloth of canvas is laid on each side and secured to the travellers, and the whole form what is termed the *Bonnet*. The upper part of the bonnet is attached to a swinging T bolt on the sling-hoop (see D, page 167,) this allows

the bonnet, which forms the *centre* cloth of the sail, to work in harmony, or in other words to blow out freely with the whole sail. As the yard ascends or descends the bonnet is drawn up or shoved down the division of the sail which is thus kept closed up. The foregoing sketch shows a topsail fitted with bonnet complete, and bent to the yard.

The sketch given below exhibits a topsail close reefed.



The following are more detailed instructions concerning fitting Topsail-yards and Sails with "Cunningham's Patent."

SAILMAKERS' DEPARTMENT.

A certain new portion of middle cloth, with the Patent Bonnet fitted complete to it, is supplied with the Patent Gear, and the duty required of the Sailmaker is simply to take out so much of the *old middle-cloth* and put in the new. In new sails so much of the middle cloth will be *left out* and the patent one put in. Stray ends of the roping on the new middle cloth are left to splice into the head rope. In an old sail, the points and cringles must of course be taken out. It is recommended to have a close-reef band and cringles, for the purpose of shifting and bending a *close-reefed* topsail, in the event of its splitting in a gale of wind.

MAST MAKERS' DEPARTMENT.

There are no cleats required to be worked in the yardarms of Cunningham's Patent Yards. The arms are carried out full and round to the lifts; about one foot of the yard, at the slings, is worked eight square; and care must be taken to get the squares as true as possible. The Jackstays are made of wood in the ordinary manner, only they must be made deeper towards the yardarms; * the intention of this is

* The difference of $1\frac{1}{2}$ inches increased depth at the outer end is generally found to be sufficient.

to make up for the taper of the yard, so as to keep the sail set tight and fair. A batten of the same proportions as the jackstays, but one foot shorter, is also put on the underneath *after*-part of the yard, to assist in taking up the slack sail.*

Figure 3, Page 167, shows the lines of a patent topsail yard. The hole *B* is for the earing to pass through, and must be grooved and smoothed out in the direction of it. Before the jackstays and battens are fixed, of course the ironwork must be put on; the centre boss must be driven on with care, but as tight as possible; and when brought *truly* in the centre of the yard, must be secured by two short bolts on each side of it. Besides the yard a spar is required, called the "Chafing Spar."—(See Figure 1, Page 167.) The intention of this is to keep the rolled-up sail off the lee-rigging, &c., and to carry the topgallant studdingsail booms.† This spar is recommended to be entire from lift to lift, and slightly tapering, say $1\frac{1}{4}$ inch; the ends must be hooped to receive the starts, which are driven into them, and which connect the chafing-spar to the yardarm hoops. *Great care must be taken in driving these starts in, not to drive them too far, so as to compress the yard armhoops, and thus prevent the free working of the yard in them.*

The following is a scale of the sizes of Chafing-Spars:—

Size of the yard at slings.	Size of Chafing- Spar at slings.
7 inches.....	2 $\frac{1}{2}$ inches.
8 ".....	2 $\frac{1}{2}$ " "
9 ".....	3 " "
10 ".....	3 $\frac{1}{2}$ to 3 $\frac{3}{4}$ " "
11 ".....	4 $\frac{1}{2}$ to 4 $\frac{3}{4}$ " "
12 ".....	4 $\frac{1}{2}$ to 5 " "
13 ".....	5 to 5 $\frac{1}{2}$ " "
14 ".....	5 $\frac{1}{2}$ to 6 $\frac{1}{2}$ " "
16 ".....	6 $\frac{1}{2}$ to 7 " "
18 ".....	7 to 7 $\frac{1}{2}$ " "

The inner head-earings in the centre of the topsail is confined to the yard by screw stud-bolts. These bolts are placed on the yard at the following distances from the centre of the yard:—

All yards up to 9 $\frac{1}{2}$ inches.....	4 $\frac{1}{2}$ inches.
Ditto, above 9 $\frac{1}{2}$ inches.....	5 $\frac{1}{2}$ " "

The bolts are so placed as to allow the head-rope of the sail to be clear of the jackstay, say $1\frac{1}{2}$ inches before ditto, and the distance they stand off from the yard must be enough for a piece of two-inch rope to hook over them. The inner end of the jackstays must be placed say two inches outside of the earing bolts:

* It is sometimes found necessary to apply another batten if the sail has much belly, by reason of its being roped tight.

† Quarter-irons, or saddles, are sometimes applied to the chafing-spar, to carry the heels of the studdingsail booms.

Figure 2, Page 167, shows the arrangement for the lead of the foremost part of the topsail-tie. This drawing shows a second sheave-hole at the mast-head, through which the tie is led, a score being cut in the heel of the topgallant mast to allow it to come up clear.* Starts with heads are driven into the ends of the yard for the topmast studdingsail haulyard block to hook to, which are to be fitted with clip-hooks, or eight eye-rings.

RIGGERS' DEPARTMENT.

Figure 1, Page 167, shows the plan of rigging the topsail-yards. The foot-ropes go abaft the topmast, and the inner ends seize on to the chafing-spar on opposite side of mast. The two quarter blocks *b b* are for the inner lead of the topgallant sheets, which have been previously led down through the iron blocks *a a*. The chafing-spar is lashed at each quarter to eye-bolts on parrall. The mode of connecting yard to parrall is by means of the two drop-bolts; a turn of the quarter lashing of chafing-spar must be taken through these bolts to keep them down and from coming out.

Figure 2, Page 167, shows the lead of the topsail ties, and also the *length* of them. The clew-lines are brought to the cap at the block C, and a downhaul tackle is fitted to assist the yard down at D. *This downhaul must never be omitted.*

INSTRUCTIONS FOR WORKING CUNNINGHAM'S PATENT SELF-REEFING TOPSAIL.

TO BEND THE SAIL.—Put the eyelet-holes in middle of sail over the iron bolts or studs on each quarter of the yard; secure the upper part of bonnet to the swinging iron; then haul out head carings, and bend the sail in the usual manner.

TO HOIST THE WHOLE TOPSAIL.—Hoist on both haulyards.

N.B.—If the after-haulyards are hauled upon more than the foremost ones, the head of the yard will cant over and bring the jackstay under it; a little care should therefore be taken to hoist on both haulyards alike. If the jackstay should be brought under the yard, hoist on the foremost haulyards *alone*, slacking a little on after-haulyards. It is a good plan to get a turn in the yard before hoisting on both haulyards.

TO REEF THE TOPSAIL.—Lower away on after-haulyards, and pull on foremost or reefing ones, until the sail is set taut.

N.B.—The downhaul is provided to assist the yard down should it require it.

* A roller is also let into the heel of the topgallant mast.

TO SHAKE OUT REEFS.—Hoist on after-haulyards, slack a little on foremost or reefing ones.

N.B.—If the foremost or reefing haulyards are merely steadied in the hand during hoisting, they will slack themselves as much as is needed.

TO REEF THE SAIL WITH THE YARD ON THE LIFTS.—Let go the after haulyards, and haul away on the foremost or reefing ones.

TO SHIFT A SPLIT CLOSE-REEFED TOPSAIL, AND BEND AND SET ANOTHER ONE CLOSE-REEFED.—Pass earings through close-reef cringle, round the spur of the yardarm iron, or where the topgallant sheet blocks are, taking care that they (the earings) are quite clear of the yard. Take, say a dozen lengths of rope that will reeve through the eyelet-holes in the close-reef band, knot the ends, and reeve them through so many eyelet-holes from *forward to aft*, so that they shall come through *abast* the sail; let two or three of them be rove through the first two or three eyelet-holes from the bunt of the sail, so as to support the sail well amidships. Then clew up the sail, haul up the bunt-lines, and hitch the aforesaid points round the chafing-spar. The two nearest the bunt of the sail may be made fast to the eye-bolts on partall. Disconnect the upper part of bonnet from swinging-iron. Take a turn with downhaul, unbend sheets, keeping bunt-line fast. Overhaul the foremost haulyards, and haul on after-haulyards, so as to unroll the sail to head. Unbend the sail, and ease in close-reef earing, and secure all for sending down sail. Make the bending sail up so as to leave upper and lower part separately clear, which can be done by passing strong stops through eyelet-holes of close-reef, **PREVIOUSLY HAVING SHOVED BONNET CLOSE DOWN TO CLOSE-REEF.** Send sail up; haul out close-reef earings, and pass earings as before described. Support sail amidships, bend the sail, cast off stops of upper part of sail, overhaul after-haulyards, haul on foremost ones, so as to roll up sail to close-reef—a Hand, if necessary, laying the leeches clear on yard. Connect upper part of bonnet with swinging-iron. Bend top-sail sheets, and cast off stops of lower part of sail. Sheet home the topsail. Cast off close-reef earings, &c. Mend the reef, if necessary, by hoisting the topsail a few feet, and reefing again.

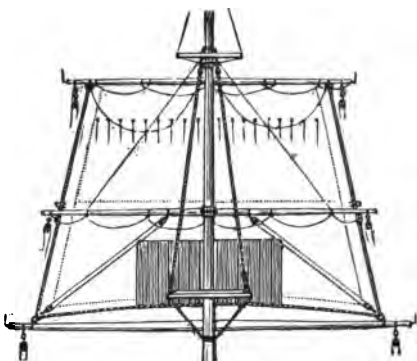
The FOREMOST, or reefing, haulyards, are those which come up BEFORE the yard.—The AFTER haulyards are those which come up ABAST the yard.

In making a CUNNINGHAM'S TOPSAIL, it is requisite to have an ODD number of squares in the foot; and in cutting-out, so much of the middle-cloth will be left out as will take in the whole length of PATENT CLOTH supplied. It is found that rather a square-headed topsail, with hollow leeches, stands best, and the leech-ropes are not apt to ride over the yard.

HOWE'S PATENT RIG.

CAPTAIN HOWE'S rig for close-reefing topsails, differs from the common rig, by having is trussed to the lower cap, and instead of slings, is supported from below by a crane upon the forward rim of the top. The yard now is entirely suspended to the cap. The lower topsail, therefore, is the size of the close-reefed sail of the ordinary rig, and sets entirely by the sheets. The upper topsail sets upon the part of the topmast above the cap, and has its foot laced to a jackstay upon the fore-cant of the yard below, so that no wind can escape between the "two topsails." This arrangement of the yards has many advantages. Labour and time are saved in reefing; a ship can be reduced to close-reefed topsails at any time, by lowering the upper topsails, which will then lie becalmed before the lower topsails, remaining perfectly quiet in the roughest weather, and can be furled or not. In squally weather, then, this rig is invaluable, for whole topsails can be carried to the last moment, and instantly reduced to close-reefed topsails with certainty of action, without the necessity of a man leaving the deck. Its economy in the wear of canvass must also be very great, for the sails are of manageable size, and have neither bunt-lines, reef-tackles, or clue-lines to chafe them.

Any ship with the ordinary rig can adopt the new, by a yard to the cap and cutting the topsails in two; and, if thought proper,



enlarge the breadth of the head, so as to spread more canvass on the same length of yards, as there is no room required for reefing outside the brace bands: the reef tackles and blocks will make the braces for the yard at the cap.



It may here be observed that in the ordinary rig the trestle-trees are never relieved from the continual heavy pressure of the weight above, until the topsail-yard is on the cap, and they are frequently found defective from this cause alone. In Howe's rig much relief is given by the half-sail and light upper yard at the top-mast head; and when both the two topsails are set, if the topsail halyards are let go, the weight of the upper topsail is no longer resting upon the trestle-trees, as is the case in the old rig.

Again, should a ship lose her three top-masts on a lee shore, blowing hard, by cutting away the wreck she would work off under the lower topsails and courses, which she would have no chance to do under the old rig, especially in cold weather with a Lascar crew, or shorthanded, as many vessels are now sometimes obliged to leave the Colonial ports to sail round Cape Horn.

A ship with this rig is more seaworthy, because she may always be considered as under close-reefed topsails, and may be worked with fewer men than a vessel of the same size having the old rig. It looks rather clumsy in port, and this, we believe, is the principal objection urged against it by those who do not comprehend its advantages at sea. Ships, however, are rigged for service at sea, and not for show in port; that, therefore, which is the most serviceable is certainly the best.

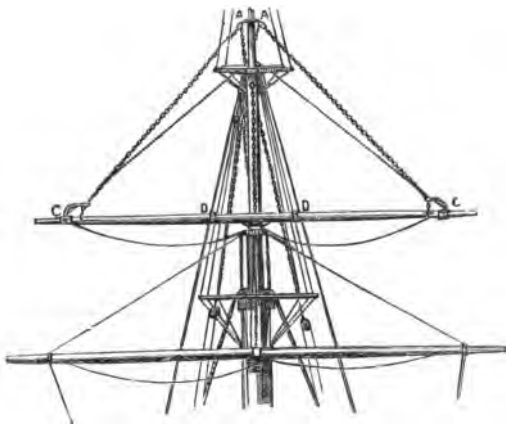
TO DETERMINE THE SIZE OF A TOPSAIL ON HOWE'S RIG.

1. The *hoist* of *upper*-topsail.—Allow 2 inches for every 3 feet in hoist or measure taken from the *spider-hoop*, down to the centre of the lower topsail yard (see p. 6).—2. The *hoist* of *lower*-topsail.—Subtract 1 ft., for drift and sheeting home, from the distance the lower yard is below the top of cap.—3. *Head* of *upper* and *lower*-topsails.—Subtract 2 ft. from the hounded lengths of the *two* topsail yards.—4. *Foot* of *upper* and *lower*-topsails.—Subtract 3 ft. from the hounded length of the yard at the cap, and the lower-yard.

COLLING AND PINKNEY'S PATENT SELF-REEFING AND FURLING SAILS.

Messrs. Colling and Pinkney, of Sunderland, are also inventors of a plan for self-reefing topsails, &c., from the deck, without sending a man aloft to reef or furl. Their invention consists in the adaptation of a roller or *rolling spar* to the foreside of the yard, in such a way that it gives additional strength, whilst, at the same time, adding little or nothing to the weight aloft over the old plan, where no reefing apparatus is used.

The sail can be wound up entirely on the rolling spar, like a "window-blind," by means of a parbuckle or reefing halyards, which leads



from the topmast head to the yard-arms, and adds materially to the strength, insomuch that it will be next to impossible to carry the yards away with this arrangement. The whole construction is so very *simple*, that any seaman immediately understands it on once seeing it. This invention can easily be applied to ships having no reefing apparatus, as it is not necessary to alter the yards or sails—only the points are

to be taken out and reef-criegles. The sails being reefed without straining or shaking, will wear much longer, and are much more simple in their construction, and cost less at the first cost, there being no reef-points, bands, or gaskets.

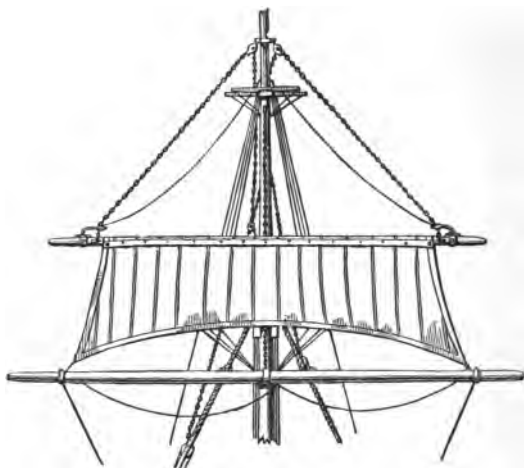
A great number of ships having been fitted, and having been used in all climates and all weathers, has proved them to answer all that could be desired in a self-reefing sail.

This invention will be readily understood by reference to the accompanying sketches, and also enable any one to fit up the Apparatus.

MAST-MAKER'S MEMORANDUM.

The yard should be made straight on the foreside, so as to allow the roller to lie as close as possible, and the hounds of the yard should be about 9 inches outside the topgallant-sheet sheave hole.

The *crutches*, D D, as per sketch (see p. 175), for supporting the middle



of the roller, should be placed—say for a 30 feet roller—3 feet from the sling hoop; and, for a 40 feet roller, 4 feet from the sling hoop, and so on in proportion to the length of the roller. Care should be taken in fixing the *journals*, carrying the ends of the roller, so that it will be directly in front of the yard: and, before the crutches are made securely fast, the roller should be allowed to bear its own weight upon the spindle; they should then be placed, so that the roller comes near to the topside, so that the roller will bear a great part of the weight before yielding to the crutches, and thus enable it to work

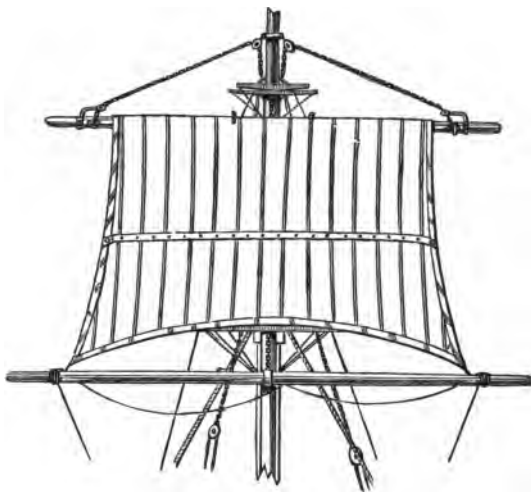
much easier, and without friction to the sail. In all cases the *stud* in the sling hoop should be on the fore cant of the yard.

The *battens* to be left 6 inches short on each side of the crutch, and one should be made of hard wood, to form a *jack-stay*, and in no case should they go without the leech-rope of the sail; they should be of the same thickness as the leech-rope is in diameter.

The *roller* should swell $\frac{1}{2}$ or $\frac{3}{4}$ of an inch in the middle.

SAILMAKER'S MEMORANDUM.

The sails should be made with nearly a straight leech, and it will be well to put holes in topsails for the close-reefs and earings. The

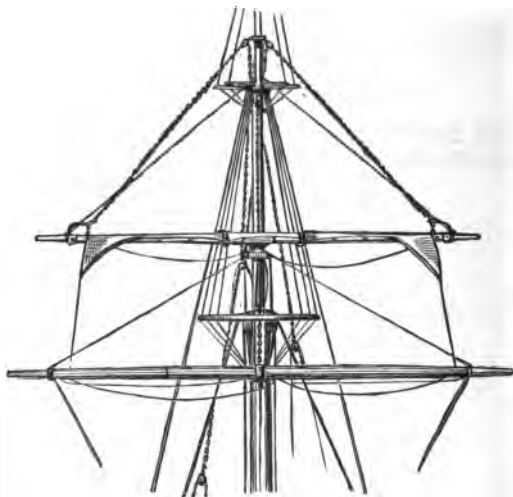


topsail at the *close-reef* should be 12 inches short of the roller at each end.

RIGGER'S MEMORANDUM.

On reeving the reefing halyards, first reeve the chain in the sister-block marked B on the sketch (see p. 175), then take up both ends of the chain and reeve each end through the blocks A A at topmast-cap, and then through the blocks or bull's-eye on the standards C C on each yard-arm, and thence the ends are wound round the roller over the fore part, and as many turns on the ends of the roller as will be sufficient to reef or furl the sail, as the case may be, and each end is then shackled to

the ends of the roller to an eye-bolt, observing to take about six turns for close-reefing, and about nine turns for furling, which will be found sufficient. The runner is rove through the sister-block B, and one end secured in the top, the other end leading to the starboard side of the



deck with a tackle attached. A down-haul to be attached to the under part of the yard, to assist the yard down, as will be seen in the sketch.

INSTRUCTIONS FOR REEFING AND FURLING.

To Reef.—Make fast the reefing halyards on deck, then ease away the topsail halyards, and as the yard descends, the roller revolves, and the sail will be reefed down to the cap.

To Furl.—The sail being thus close-reefed, the topsail halyards are made fast, the sheets are then “started,” and by hauling on the reefing halyards, the whole sail is wound easily on, and thus furled without sending a man aloft.

To Unfurl.—Let go the reefing halyards and haul the sheets home, then pull on the topsail halyards, and as the yard ascends, the chains are wound round the roller again,* and the whole sail set as required.

* It will be observed that when the sail is *furled* the chains are unwound, except about half a turn round the roller.

PITTARD'S CUTTING BOARD OR TABLE.

MR. CHARLES PITTARD,* of London, has kindly sent to the author a sketch and description of his Cutting Board, or Table, for cutting out any sail required; also, upon which to cut up *bands*, at the rate of one bolt of canvass per minute, into one-half, one-third, and one-fourth breadths, cut and made up at the same time. This would be found a great saving of time, as well as accuracy of cutting the bands. By a reference to the following plans or sketches, it will be seen this table is both simple in construction and much easier for our work, than having to go on to the floor upon hands and knees, for every gore required to be cut, which, in some sails, are not trifling. We shall now endeavour to explain the sketches, so that any carpenter or joiner may be able to make one of these tables.

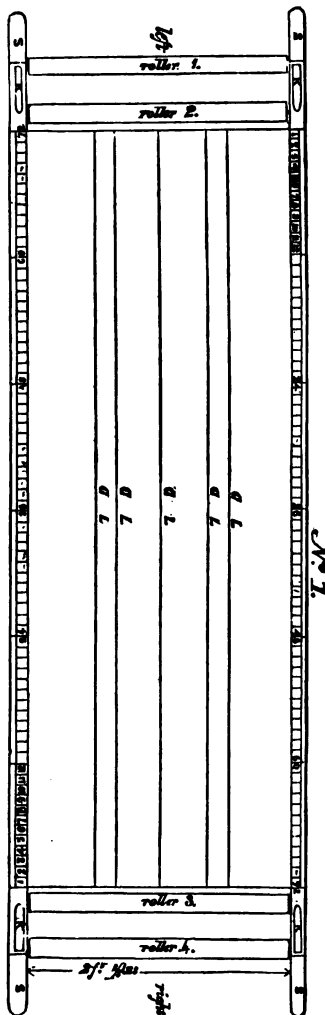
No. 1 sketch represents the table top complete, and ready for cutting out. The length of it is 6 feet. The two side pieces of the frame must be 8 feet long, for the rollers to fit into, and to keep the canvass in gauge. No. 1. R R are two rules let into the table-top, and figured in inches on either side *alternately* 1 to 72 inches, as shown. S, on each corner of the frame, are shields to receive the blade of the knife, and to prevent the knife being thrown down, or cutting any person in passing by it. These shields are made of wood, thus,—the top being rounded every way, to prevent the canvass or anything else catching them. It is best to make the shields in two halves—taking out a little of the wood to receive the blade of the knife; and then glue the halves together, and afterwards glue them to the table in the proper place.



The frame must be well made and put together strong, or it will soon become rickety. It is recommended to have all the timber well-seasoned, and the top of the table made *very smooth*. The frame to be set to 2 feet $\frac{3}{4}$ inch, or 24 $\frac{3}{4}$ inches—clear distance. The rollers are 2 feet long exact, leaving $\frac{3}{4}$ of an inch play, and have iron gudgeons which work in brass plates about $\frac{1}{2}$ an inch thick, let into

* Mr. Pittard is foreman sailmaker to Messrs. George Robertson & Sons, Commercial-road East, opposite Limehouse Church, London, where any person calling could see his table before getting one made.

the sides of the frame; all the rollers are 2 inches diameter, and



tipped with brass ferules. The tops of rollers, Nos. 1, 2, 3, and 4, must be level with the top of the table, for passing the cloths to and fro. The legs of the table are 3 inches square, and the frame, top, &c., $1\frac{1}{2}$ inch when dressed. There are four stout cross-pieces close up under the top, and well secured to the frame.

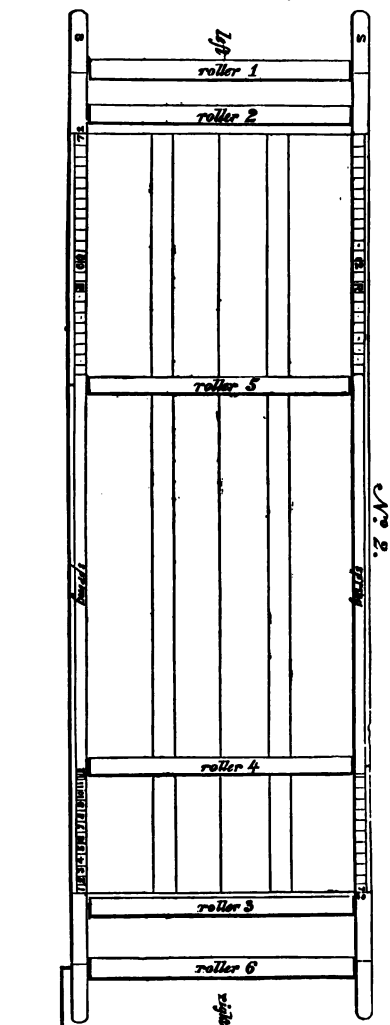
In the annexed sketch, No. 1, the rollers, Nos. 1, 2, and 3, are fixtures; No. 4 must be made to shift by taking out a wedge piece of hard wood at the side, which will enable that side of the roller to be lifted and taken out, and placed in the spring, when the workman requires to cut up bands. See Nos. 2 and 3 plans. This roller is used in Nos. 2 and 3 plans, as shown on them; in this plan it is not really necessary to have No. 4 roller, but as the inventor was obliged to have six rollers in all, and a place to keep them, it was as well where he has placed it as anywhere else, and looked more uniform.

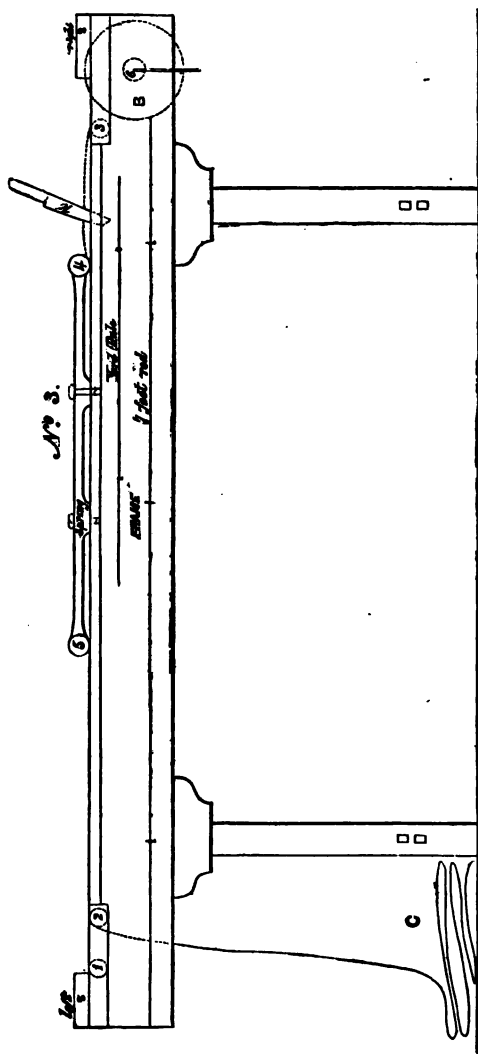
The gauge-lines, G L, are merely heavy scratches done with a carpenter's gauge, not really necessary, but very handy at times. The annexed sketch, No. 2, shows the table-top with roller No. 6, for winding the bands on, with an iron crank handle, which will unship and stand on one side when not in use. You will observe that this roller, No. 6, does not ship into the same socket as No. 4, but lower down, as shown on No. 3 plan, into an angle groove, to prevent it from jumping out

when in use. A side hook will also be found useful to prevent the roller jumping. The roller No. 4, and spare roller No. 5, are shipped into the springs, ready for cutting bands. There are five niches made in the five gauge-lines (betwixt rollers Nos. 4 and 3) for the point of knives to fit into, which must not be larger than will hold the knife firmly.

The succeeding sketch, No. 3, is a side view of the table, showing the rollers, springs, knife, canvass cut (or B, a bolt of canvass on roller No. 6 cut into bands), and canvass to be cut as C, &c. The springs, which are made of lance wood, ash, or American elm, are fastened down to the table with four common thumb screws, such as are used for fastening window shutters, and with the brass plate let into the table at three and four feet on the rule. The knife, K, is shown in one of the niches; and the canvass passing under the rollers; also the size of the bolt of canvass cut into bands, at B, on roller No. 6.

At the side of this view, you will observe some common brass curtain hooks, for resting the yard stick, and a long rod, or straight edge, for marking long gores—a very handy and ready place to keep them. It





is well to have these on each side, so that you can put your hand on them when wanted.

The roller No. 6, with crank handle fixed, must have four hollows or scores cut into it, about $1\frac{1}{4}$ inches long; in each of these hollow places there must be a small hook on a loose eye, to fasten the canvass, before you begin to turn the roller; this will prevent slipping. When you have cut your bolt into the bands, draw your roller out of the socket parallel with the table; give your roller one turn backwards; this will release the hooks from the canvass, and fall down into the hollows; you can then draw your roller easily out of the canvass.

The knives, when used in No. 3 plan for cutting bands, must be in good order, and quite free from notches, or you will pull them out of their places, and perhaps do some mischief.

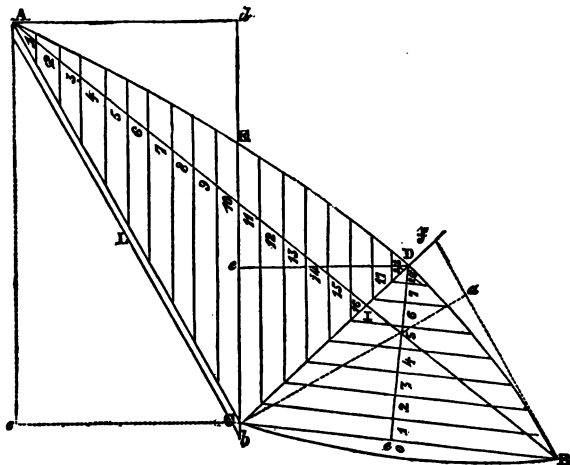
Mr. Pittard never makes a practice of sharpening his knife on a stone of any kind, but sharpens it on a board with brick dust, and, occasionally, a dust of mastick out of a pepper box.

In cutting out, as in ordinary cases, you place your bolt of canvass on your left hand. If a square sail is required:—measure off first your striking cloth, and cut one by the other: your cloth as cut will be found on your right hand; your bolt of canvass from which you are cutting will pass over No. 2 roller, and your striking cloth over No. 1 roller; this will prevent friction, and work much easier. If a fore-and-aft sail is required: Place, as before, the canvass on your left; commence your work as usual, and cut away first on one side of the table, and then on the other. As, in ordinary cases, your canvass will thus pass first over No. 2 roller, and then over No. 1, your cloths as cut will be found half at each end of the table; but to keep your canvass free from the weight of the cloths you have cut, pass them as you proceed to that end of the table marked “right:” the whole of your sail, or cloths, will then be found together, when you have done, on your right hand.

The cutting of long-gores is as simple as the construction of the table itself; for since the table is 6 feet long, with rules on each side figured in inches up to seventy-two, how easy is it to have or quarter the length of gore required, and so mark it off until you have got your full length of gore ready for the knife. Say you require 24 feet gore:—mark 6 feet (the length of table) to the four quarter-breadths of your canvass, and you have 24 feet. Indeed, you can, by quartering, mark a gore 28 feet long; for the canvass will lay over the rollers, which are level with the table top, for you to mark a gore 7 feet long. This is the most useful part of the “straight edge” or rules at the side of the table, and which are always ready to hand, for long or short gores.

PITTARD'S IMPROVED ANGULATED JIB.

The following sketch exhibits Mr. Pittard's mode of cutting jibs, of which he has informed the author that he has cut several this last



10 years upon this formation or construction of the canvass.* At page 93 of this work is given an outline of a jib on a construction similar to this sketch, but the line C D, which represents the last, is inadvertently shown at right angles with the leech, for the strain of the clue to stay, which is not intended to be the direction of the pull of the jib-sheets. Mr. Pittard, however, has adopted a rule for placing the last. He says that the last should be at least 5 feet above the perpendicular C a to the leech, which he has noticed for some years to be the place where the greatest strain of the jib-sheet comes. For these sails he has also laid down a rule for the flow of the stay, viz.—2 inches for every yard of leech, and 2 inches for every foot of rise to the clue, added, and will give a very fair allowance for the flow of the stay. Say a jib of 12 cloths, 13 yards leech, and 16 feet rise by clue:—13 yards by 2 inches, equal

* The author was not aware that his friend Mr. Pittard, or any one else had made jibs upon this principle before he published the plan in his last edition of *SAIL-MAKING*.

26 inches, and 16 feet rise by 2 inches, equal 32 inches, added, will give 58 inches, or D I 4 feet 10 inches flow of stay.

As it regards to the cutting out of these sails, they ought be done in three distinct parts, the part below the last being one, that above the last two, and the third the leech part.

FIGURES FOR THE ABOVE JIB.

Jib equal 12 cloths, 13 yards leech, and 16 feet rise by clue, of 2 feet canvass.—By construction, as per sketch, foot B C 27ft. 9in.; C e 13ft. 2in.; B e 14ft. 7in.; D e 14ft. 8in.; A d 19 ft.; C E 23ft. 9in.; E e 10ft. 7in.; E d 10ft. 6in.; A e 34ft. 3in.; and C b 15in. allowance for tabling L.

1. The foot part cut 28 feet 1 inch, being 4 inches to allow for last.

Nos	Last-gores.	Stay-gores.	Ins.
	Ins.		
1	20½	19	
2	20½	20	
3	20½	20	
4	20½	21	
5	20½	22	
6	20½	24	
7	20½	27	
8	14	23	
158, C e		175, B e	
		158	

12)333

B c—27 ft. 9 in.

2. The middle-part cut from clue-seams C E, 25 feet, which allows 15 inches for leech tabling.

Nos.	Stay-gores.	Last-gores.	Ins.
	Ins.		
11	15	20½	
12	15	20½	
13	16	20½	
14	16	20½	
15	17	20½	
16	17	20½	
17	18	20½	
18	13	14	
127, E e		158, C e	
		127	

12)285

C E—22 ft. 9 in.

3. The leech-part cut from clue-seams C E, 25 ft. which allows 15 inches for leech-tabling.

Nos.	Stay-gores.	Leech-gores.	Ins.
	Ins.		
10	14	42	
9	14	41	
8	13	41	
7	13	41	
6	12	41	
5	12	41	
4	12	41	
3	12	41	
2	12	41	
1	12	41	

126, E d 411, A e
126

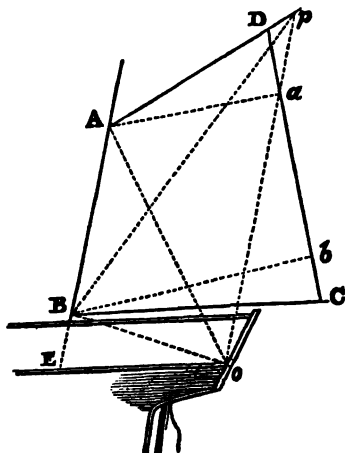
12)285

C E—23 ft. 9 in.

Note.—There will be 25 seams instead of 11, which must make the sail the stronger. No broad seams. Stay and leech-ropes all one size—the leech-rope a little taut, and the clue strain-band of these sails to be run across to the stay.

ON MEASURING FOR A MIZEN, WITH A GAFF FIXED, AND BOOM UNSHIPED.*

This is done as follows :—The annexed sketch is drawn with the boom in its place, but that is only to show the thing more distinct.



After taking the measurements A E, 30ft. 10in.; A B, 24ft. 6in.; E O, 20ft.; B O, 20ft. 2in.; A P, 27ft. 5in.; B P, 47ft. 3in.; P O, 44ft. 8in.; A D, 23ft. 10in.; C D, 27ft.; B C, 32ft.; and A O, 33ft. 10in., the student will find, if he will take the trouble to lay it upon paper to scale, that the lines from throat to deck, or A to O, and from gaff end to tack, or P to B, will check the other figures—it will detect any error that may arise in measuring or laying down his drawing. The method of measuring is this—the tape is made

fast to the signal halyards, and run up to the gaff-end, and thereby avoiding the sending a boy out, and running the risk of breaking his neck. With tape at signal halyards, the dimensions A P, 27ft. 5in.; B P, 47ft. 3in.; and P O, 44ft. 8in. are got; and you can easily run the tape into the chain topping-lift near the gaff-end, and take the length of the chain to the boom-end, which, with the boom unshipped, will be hanging inboard; this, with the length of your boom (after you have correctly laid down the other portions of your work), will give you the exact angles of the sail; or, supposing that there is no chain topping-lift, your boom can easily be put into its right place, by giving sufficient height above the deck for the man at the wheel, which say 6 or 6 feet 6 inches.

The figures and allowances for stretching will always vary, according to the different angles of the sail. The greater amount of

* This method of measuring, and the figures for cutting-out this and following sail, were kindly presented by Mr. Charles Pittard.

foot-gore, the more must be allowed for stretching; and the less amount of foot-gore, the less the sail will stretch.

FIGURES FOR CUTTING OUT THE ABOVE SAIL.

Head, 11 cloths; foot, $15\frac{1}{2}$ cloths; mast, $7\frac{1}{2}$ yards; and leech, $11\frac{1}{2}$ yards.

Slack- Cloths. Foot- Head-
seams. gores. gores.

Ins.	Ins.	Ins.	Ins.
2 ... 1 ... 6 ... 3			
2 ... 2 ... 3 ... 3			
2 ... 3 ... 2 ... 4			
2 ... 4 ... 1 ... 4			
2 ... 5 ... 0 ... 5			
1 ... 6 ... 1 ... 5			
1 ... 7 ... 2 ... 6			
1 ... 8 ... 3 ... 6			
1 ... 9 ... 4 ... 7			
1 ... 10 ... 5 ... 8			
1 ... 11 ... 7 ... 11			
12 ... 9 ... — ... 60			
13 ... 11 ... — ... 61			
14 ... 13 ... — ... 62			
15 ... 15 ... — ... 62			
$\frac{1}{2}$... 5 ... — ... 16			

16	75	62	261
			62
			75
			16
			414
			12
			12)402

	Yds.
Body No. 4, canvass.....	138
Clue-piece	$4\frac{1}{2}$
Peak-piece	$1\frac{1}{2}$
Splice-piece	1
Mast-lining	4
Three 4 cloths strain bands 6	
Total	155

Seams.—Head 2 inches, and foot 3 inches—2 reefs in foot.

33ft. 6 in. length of leech.

N.B.—It will be observed that the slacks are very little, not more than will stretch out in rubbing down the seam. This sail is cut from the leech, and shows greater amount of confidence than cutting from the mast, but it is just according to what you accustom yourself to.

MEASUREMENTS AND PARTICULARS OF A LARGE SHIP'S SPANKEE.

MEASUREMENTS.—A B, 23ft. 9ins.; B F, 49ft. 4ins.; A P, 30ft. 2ins.; C D, 40ft. 11ins.; B C, 45ft.; and from throat to sheet, 46ft. 9ins. See preceding sketch.

FIGURES FOR CUTTING OUT

Head, $14\frac{1}{2}$ cloths; foot, $20\frac{1}{2}$ cloths; mast, $7\frac{1}{2}$ yards; and leech, $12\frac{1}{2}$ yards.

Slack-seams.	Cloths.	Foot-gores.	Head-gores.	
Ins.		Ins.	Ins.	
3	...	1	...	5
3	...	2	...	3
3	...	3	...	2
2	...	4	...	3
2	...	5	...	0
2	...	6	...	1
2	...	7	...	2
2	...	8	...	3
2	...	9	...	4
2	...	10	...	5
1	...	11	...	6
1	...	12	...	7
1	...	13	...	8
1	...	14	...	9
1	...	15	...	10
	...	16	...	12
	...	17	...	14
	...	18	...	16
	...	19	...	18
	...	20	...	21
	...	$\frac{1}{2}$	...	12
28		148	57	228
				57
				148
				28
				461
				11
				12)450

37 ft. 6 ins. length of leech.

Width of seams—head, $1\frac{1}{2}$ ins.; and foot, $3\frac{1}{2}$ ins. Ropes—head, $2\frac{1}{2}$ ins.; peak, $3\frac{1}{2}$ ins.; leech, $2\frac{1}{2}$ ins.; clue, 4 ins.; sheet, $2\frac{1}{2}$ ins.; foot, $1\frac{1}{2}$ ins.; and mast, $2\frac{1}{2}$ ins.

TRIANGULAR LOWER STUDDING-SAILS.

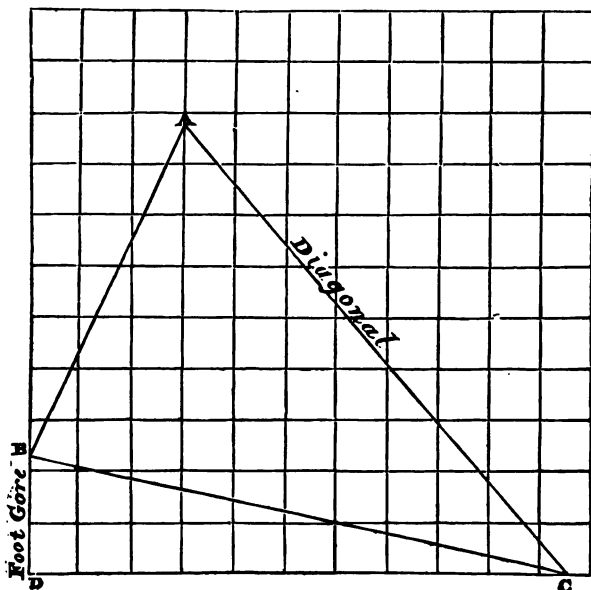
The reader will find noticed the recently-invented Triangular Lower Studding-sails at page 74, but no figures for cutting. It is thought necessary that some examples should be given, as the various cuts of these sails, which are to be seen, clearly demonstrates that the principle upon which they ought to be cut is not generally understood. The generality of these sails are cut too *lean*. They ought to be cut with a good round in the outer leech, and a little round in the head, which is done to equalise the flow of the sail; also to put a little broad seam in the head, say $1\frac{1}{2}$ inches, and $2\frac{1}{2}$ inches in the foot or outer leech. See examples for various tonnages at page 164.

Body No. 2, canvass.....	200
Clue-piece	4
Peak-piece	2
Splice-piece	1
Mast lining	4
5 cloths band	$2\frac{1}{2}$
$\frac{1}{2}$ breadth reef band	$6\frac{1}{2}$
Total.....	220

This sail had a reef with half breadth band from the clue to the halfway of head; this method for reefing a ship's mizen is approved of by many captains. The reef-holes are 18 inches apart.

TABLE OF SQUARES.

In order that the reader may understand what is meant by "working with a Table of Squares," we here give him a diagram:—

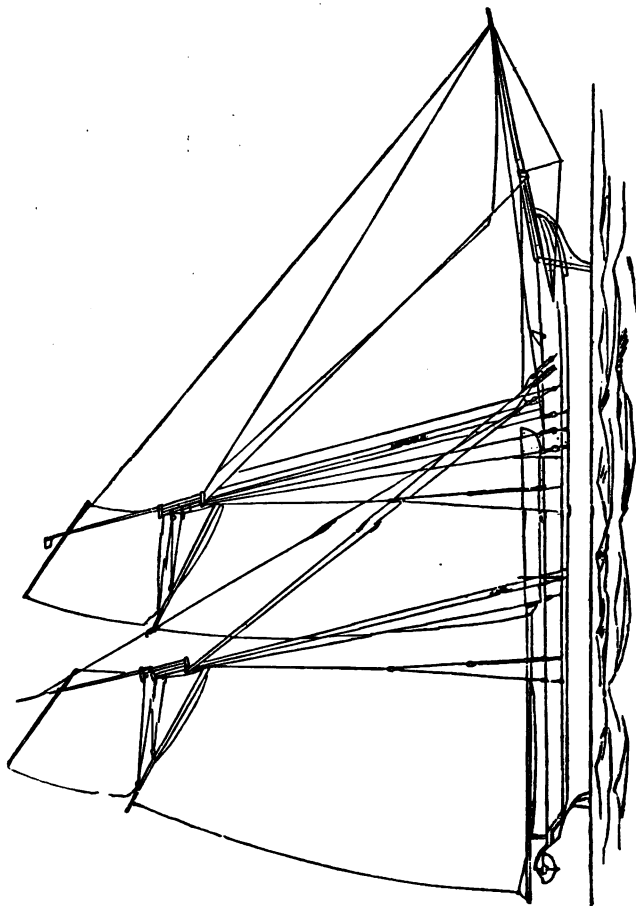


EXAMPLE.—Suppose you have just returned from taking the dimensions of a *Mainsail*—boom, 42 feet; gaff, 30 feet; luff, 28 feet; and diagonal, 46 feet. The scale of squares $\frac{1}{4}$ inch to a foot, but we shall call $\frac{1}{2}$ of an inch to a foot each of the squares, making 4 feet instead of 2 feet. First, from the dimensions given, we have the difference between the boom and gaff 12 feet, which is equal to three squares of the table; then with the length of luff, A B, measure off 28 feet; this done, take the diagonal, A C, 46 feet, and boom, D C, 42 feet, equal to $10\frac{1}{2}$ squares; mark off the length of diagonal, A C—the distance your diagonal falls below the tack, B, is the foot-gore, B D, equal 10 feet.

This method of finding the foot-gore of any fore-and-aft mainsail is upon the supposition that the sail is a perfect plane; in other words, that the cloths are laid selvage to selvage. As to the correctness of this mode of finding the foot-gore, we would just say—that there can be nothing more correct, that is to say, if the squares are made correct; besides, the thing is done in a moment of time.

SAILS OF YACHTS.

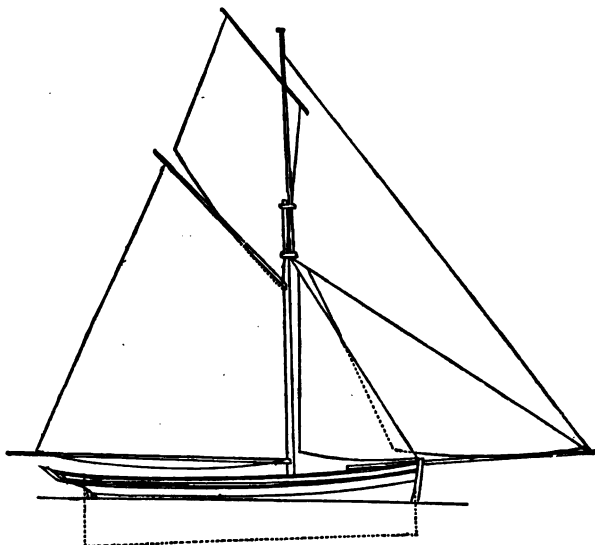
It will be recollected that the sails of the *America* yacht were made of cotton duck; and that the Americans soaped or greased their sails for the race, to make them hold the wind. It is well



known that cotton sails are lighter, easier worked, and hold the wind better than common canvass. The only advantage of heavy canvass is that it lies flatter; for this reason the most of our yachts' main-sails are made of very heavy canvass.

With respect to the sails being made flat, enough has been said at page 79 of this work, but we should add that in a schooner, if the sails are not made *flat*, the wind from the jib acts against the fore-sail, and the eddy from the foresail against the main, which, in each case, tends to retard the vessel's progress.

The following dimensions are for cutting a cutter-yacht's sails:—



Dimensions for Cutting out Foresail.

	FT.	IN.	
Stay	35	8	} After stretching.
Leech	32	0	
Foot	16	0	

No foot-gore, except for round.

Cloths.	Foot-gores.		Stay-gores.	
		IN.		IN.
1		8		63
2		4		51
3		2		47
4		1		46
5		0		45
6		1		45
7		2		44
8		4		43
9		8		39

One 5 feet reef

Dimensions for Cutting out Mainsail.

	FT.	IN.	
Head	26	0	equal 13 cloths.
Foot	35	0	equal 18½ cloths.
Leech	48		Ostretched after the sail is made.
Mast	32	0	ditto, ditto.
Head-gore	10	9	
Foot-gore	7	3	

Foot-gores. Mast-gores.

Cloths.	IN.	IN.		
½	5	30		
1	15	64		
2	13	58		
3	12	66		
4	11	71		
5	10	67		
6	9	—	Head	
7	8	—	gores.	
8	7	—	IN.	
9	6	—	16	
10	5	—	12	
11	4	—	10	Slack.
12	3	—	9	IN.
13	2	—	8	1
14	1	—	8	1
15	1 up ..	—	8	2
16	3	—	8	3
17	7	—	8	4
18	12	—	8	5
			8	8
			8	10
			8	10

This sail has three reefs, 6 feet apart; two with points.

Dimensions for Cutting-out Gaff-top-sail.

Head	3½	cloths.
	FT.	IN.
Foot	27	9 equal 15 cloths.
Leech	24	9 after stretching.
Luff	33	9 ditto.
Sheet-gore	1	6 up.
Head-gore	1	0 down at peak.

*Foot-gores.**Luff-gores.*

Cloths.	IN.	FT.	IN.
1	10	2	11
2	8	2	8
3	6	2	7
4	4	2	2
5	3	2	0
6	2	2	4
7	1	2	6
8	0	2	7
9	1	2	7
10	2	2	7
11	3	2	2
12	5	1	2 ½ cloth.
13	8		
14	12		
15	18		

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